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ABSTRACT

A study was conducted to assess the impact of three anticipated changes in the health care system on the future requirements for registered nurses. The changes investigated were the introduction of national health insurance (NHI), the increased enrollment in health maintenance organizations (HMOs), and the reformulation of nursing roles. Following a literature search which revealed that no single previous study provided significant information on the research problem, a model was developed to predict nursing manpower requirements in relation to the projected population of health consumers and the determination of its demands for health services. Based on the estimates obtained from the model's application, it was concluded that (1) of the three changes studied, future growth in HMO enrollments is the least significant; (2) if neither of the two major changes occurs, the requirements for nurses will increase by approximately 145 percent from 1972 to 1985; and (3) for either of these two changes separately, an additional increase of seven to fifteen percent is expected, while for the two combined, an extreme projection of up to an additional fifty-three percent can be made. Preliminary comparisons of these estimated increases with available supply estimates of nurses showed no alarming imbalances, although the passage of NHI without sufficient advance preparation could produce a higher demand than supply. (ELG)

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The Impact of Health System Changes on the Nation's Requirements for Registered Nurses in 1985

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FOREWORD

The Division of Nursing has assessed current and future requirements for registered nurses for over 30 years; special impetus was given to these efforts by section 951 of Public Law 94-63 (Nurse Training Act of 1975) and the impending passage of some form of national health insurance. Section 951 requires that information on the current and projected supply and distribution of and requirements for nurses be furnished to the Congress on a continuing basis. To help meet the need for new data collection tools and methods, the Division developed four manpower models. This publication reports on one of these: the Vector model developed for the Division by Vector Research, Inc.

The structure of the Vector model heavily emphasizes three major anticipated changes in the health care system: the introduction of national health insurance, the increased enrollment in health maintenance organizations, and the reformulation of nursing roles. The independent and joint effects of these changes were quantitatively determined.

An interesting feature of the model is that in converting nursing services to requirements, it takes into account the extent of role reformulation that may occur in three practice settings employing nurses in extended roles. These settings include primary nursing in hospital inpatient settings, clinical nurse specialist roles in hospital inpatient settings, and nurse practitioner roles in office practice settings.

We hope this report will give insight to the significant effects of health system changes on the Nation's requirements for nursing services, and will make an important contribution to the state of the art of manpower forecasting for nurses.

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1. INTRODUCTION

The research described in this report assesses the impact of three anticipated changes in the health care system on the future requirements for registered nurses. The three health care system changes investigated were:

1. the introduction of national health insurance (NHI);
2. the increased enrollment in health maintenance organizations (HMOs); and
3. the reformulation of nursing roles.

To analyze the impact of these health system changes on nurse requirements, estimates of future requirements in the general absence of each change were quantitatively compared to estimates incorporating substantial occurrence of the change. To estimate requirements, an empirical model of the health system was developed and applied. It used Bureau of Census predictions concerning the size and composition of the future population, estimates of the amount and type of services used by this population, and predictions of the number of nursing personnel employed to satisfy these future health service demands.

The model, which focuses solely on nurse requirements rather than supply, provides estimates of future nursing employment levels without regard to any concomitant or exogenous constraints on the availability of nursing resources to meet these requirements. That is, the purpose of the model projections is to determine how many nurses must be employed to retain the current level or maintain the current trends in the amount of nursing care provided to the population. Therefore, the term "requirements" as used in this report means the number of nurses that would be employed in the future under the following assumptions:

1. There will be no change in the wages of RNs relative to those of other health personnel and relative to the costs of providing health services;
2. The supplies of health system goods and services are perfectly elastic; and
3. The relationship between the health service demand curve and the demand curves in all other markets remains constant.

The first assumption provides that no substitution of non-nursing labor for nurse labor will occur as a consequence of providing these services at a different price. For example, there will not be a sudden influx of other types of personnel who would be employed to do the work of nurses, nor would the relative wages of RNs change sufficiently to justify economically the substitution of other labor for RN services. The second assumption implies that as service demands increase, service providers' capacity also increases such that the price of these services remains constant relative to the cost of other goods and services.[1] The last assumption states that the consumers' demands for health services will not be affected by changes associated with the non-health needs of the consumers. In short, we assume there will be no changes, other than those we explicitly address, in the economic aspects of the health system or its relationships with the general economy as we knew them in the base year.

[1]This assumption is made to enable estimation of RN requirements irrespective of the availability of nurses to fill these requirements. In those situations where the requirements for nurses may experience a sudden and dramatic increase (e.g., the enactment of national health insurance legislation), this assumption permits estimation of the nurses required, which in all likelihood will be less than those utilized because of constraints on available supply.

Project Scope

The scope of the project included estimating national requirements for two types of licensed nursing personnel, registered nurses (RNs) and licensed practical nurses (LPNs), assuming the oc-

currence of each of the above changes individually and in combination.[2] The base year selected for these estimates was 1972, since this is the most recent year for which a comprehensive and consistent set of data was available. Using this data, nurse manpower requirements estimates were made to 1975 and projections to 1985. These requirements are further categorized in terms of major employment settings: non-Federal, short-term hospital inpatient and outpatient units, physician offices, nursing homes, community health settings, HMO ambulatory clinics, other hospitals (Federal and long term), nursing education, and private duty. Requirements in the remaining settings were grouped into a miscellaneous "other" category.

Study Approach

To determine requirements for nursing personnel, a large empirically based model of the health system was developed in three phases: (1) a thorough review of other research, (2) the development of the model, and (3) the application of the model. The work performed and the results obtained in each of these phases are outlined in the following paragraphs.

In the analysis of previous studies [Cooper, *et al.*, 1974], it was found that few of them directly treated the research topic of interest—the impact of changes in the national health care system on the demand for nurses. In fact, none of the documents reviewed focused solely on this topic; rather, most studies considered to be relevant to our research addressed the problem of predicting nurse requirements in the absence of any health system changes.

These studies generally fall into two categories. In one, manpower prediction problems are viewed from a national or societal perspective and, in the other, from the perspective of a particular health care facility.

Studies from the former perspective include the 1963 report by the Surgeon General's Consultant Group on Nursing [Public Health Service, 1963] utilizing a primarily subjective approach to estimating requirements for nurses, the empirical model produced by the former Division of Manpower Intelligence [BHRD, 1974], and other models built around economic representations of the health care marketplace, including the work by Maki [1967], Deane [1971], Benham [1970], Kehrer [1970], and Hixson [1969].

Studies from the institutional perspective which address nurse manpower planning problems are those by Levine and Phillip [1973], Parker [1968], Connor [1960], Singer [1961], Thomas [1964], Laberge-Nadeau and Feuvrier [1972], and Jelinek [1964], which are all based on analyses of a group of hospitals, a single hospital, or unit of a hospital.

Previous studies which addressed the health system changes of interest generally did not focus on the nurse manpower problem. For example, Huang and Shomo [1974] estimated the effect of pre-1973 national health insurance on a broad range of health manpower types; Research Triangle Institute investigated the impact of insurance coverage on manpower requirements in the short-term general hospital setting [RTI, 1972]; and GEOMET assessed the impact of the HMO concept in a number of health manpower professions [GEOMET, 1973].

One study concerning role reformulation, the 1974 study by Applied Management Sciences [1974], examined the redefinition of roles in a number of health manpower fields and, in the case of nurse employment, primarily concentrated on the hospital setting.

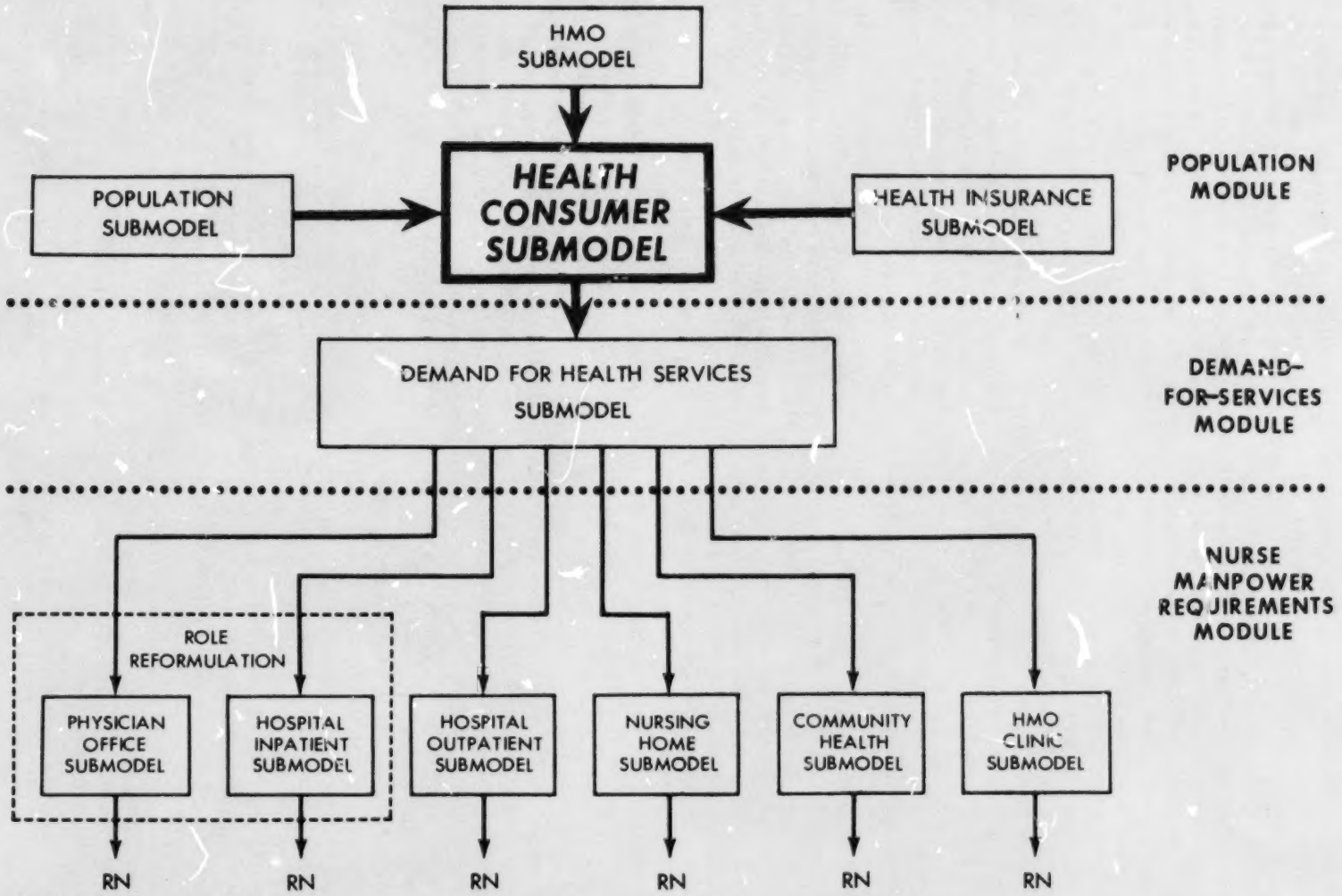
The analysis of these and other studies revealed no single study provided a significantly robust representation of the current research problem. Rather, some integration of the results from these studies, as well as an adaptation of one or more of the methodologies employed to develop their results, would provide the most useful product.

The previous work did, however, point out that the problem of predicting nurse manpower requirements falls naturally and conveniently into three parts: the projection of the future population of health consumers, the determination of their demands for health services, and the translation of these demands into nurse requirements. Thus, the second phase of the research was to develop a relatively straightforward, though extensive, empirical model[3] of each of these three components. A schematic representation of the model appears in figure 1, and is divided into three components. These correspond to the natural division of the

[2]The report is concerned exclusively with an analysis of requirements for registered nurses. Consequently, all references made to nurses or nursing personnel in the text of this report refer only to RNs unless explicitly stated otherwise.

[3]A more detailed description of this model is provided in appendix A.

Figure 1.—VRI Nurse manpower requirements model



problem just discussed and are the population, demand-for-service , and nurse manpower requirements modules.

The population module consists of four submodels. The first of these, the population submodel, describes the size and composition of the future U.S. population. The second, the health insurance submodel, describes quantitatively current health insurance coverage as well as that anticipated under alternative national health insurance proposals. The third, the HMO submodel, estimates future HMO enrollment. The outputs of these three submodels are then integrated in the health consumer submodel to characterize the future population of health consumers in terms of their age, sex, family income, and family status class;[4] their HMO enrollment status; and their private or public insurance for basic health services.

The output of the population module is then used by the demand-for-services module to estimate the aggregate demand for health services in each of six major categories. physician office, hospital inpatient, hospital outpatient, nursing home, HMO clinic, and home health care.[5] The future utilization of these health services is predicted by combining estimates of the *per capita* demand for each type of health service with the population data generated by the population module. Estimates of *per capita* demands are based on historical data available from large-scale surveys, social experiments, and research studies. These estimates are made as functions of health insurance characteristics, population cohort characteristics, and health service setting. The results from the product of these *per capita* demands and the estimated future population provide the projected amounts of services demanded in each setting.

The nurse requirements module consists of several submodels. These submodels determine the number of nursing personnel required to provide the quantity of services estimated by the previous module. In two of the settings, physician office and hospital inpatient, the determination takes into account the extent to which role reformulation may occur.[6] The physician office submodel predicts the number of nurses employed in physician offices as a function of the number of office visits demanded. The hospital inpatient submodel has the number of bed days demanded per year as input, and predicts the number of nurses required to provide these services in short-term general hospitals. The remaining submodels estimate nurse requirements in hospital outpatient clinics and emergency departments, nursing homes, HMO ambulatory clinics, and community health[7] as a function of the services demanded in each of these settings.

Parameters were developed for the model using historical data from numerous sources, published and unpublished. Then, in the third research phase the model was exercised using data descriptive of the various health system developments under investigation.

The information generated by the model includes annual projections from 1972 through 1985 of the aggregate health service demands of the population (by setting), requirements for registered nurses[8] in terms of both full-time equivalent positions[9] and total employed, and a separate tabulation of the impact of role reformulation.

The discussion in this report is restricted to requirements for full-time equivalent positions to avoid the confusion of repeating both types of estimates and provide what appears to be the more useful of these measures.[10] In addition, the results presented in this report are primarily concerned with the percent change in requirements over the projection period 1972- 1985. With the exception of trends influenced by national health insurance, which becomes effective midway through the projection period, the requirements in intervening

[4]These characteristics were employed because of their correspondence with available data and their significant correlation with health consumer behavior.

[5]This array of services was chosen on consideration of significant relationship to population trends, availability of data, vulnerability to health system changes, and potential impact on nurse requirements. For other settings in which nurses are employed, requirements are computed directly in the nurse requirements section.

[6]Only those reformulations in nursing roles that appear to affect substantially the requirements for nurses are explicitly treated. These are: (1) the employment of nurses in practitioner roles (an example of role extension in the physician office environment), (2) the increased utilization of clinical nurse specialists (an example of role expansion in the hospital inpatient environment), and (3) the adoption of the primary nursing concept (an example of upgrading the skill levels of nursing personnel in hospital inpatient units).

[7]The community and "other" submodel shown in figure 2 (page 11) is actually a set of seven separate submodels. In the community health area, separate submodels estimate the number of nurses required for home care, school nursing, occupational health, and other community health activities. The "other" portion of the submodel estimates the requirements for nurses in long-term and other hospitals, for nurse educators, and for private duty nurses. See appendix A for a more detailed discussion.

[8]Licensed practical nurse requirements were also predicted by the model in a manner similar to the RN requirements.

[9]One full-time equivalent position is equivalent to the number working full time plus one-half the number working part time.

[10]Projections are made in terms of full-time equivalent positions to eliminate the influence of future variations in part-time/full-time employment ratios. These are largely considerations of supply, and are therefore beyond the scope of this research. However, conversion of all projections to total employed are made on the basis of base year employment data (appendix B).

years tend to follow linear, or nearly linear, trends. Consequently, results for these years are not discussed in detail, except where NHI is a factor. However, annual requirements estimates are presented in full in appendix B for readers interested in this level of detail.

Summary of Results

Using the above definition of requirements, the model estimates of RN requirements indicate that the impacts of both national health insurance and role reformulation are potentially much greater than that attributable to any foreseeable increase in health maintenance organization enrollment. National health insurance (NHI), for example, could result in a 7-percent to 14-percent increase in the requirements for RNs over the 1972–1985 projection period. The extent of this growth depends on the degree of benefits provided under the postulated NHI program. Increases similar in magnitude to NHI are also possible if the role of the nurse in the delivery of health care is significantly expanded or reformulated. Moderate to extensive acceptance of the role reformulation concepts postulated in this report results in a projected increase in RN requirements of approximately 8 percent to 15 percent. Rapid expansion of HMOs, however, appears to have a limited and negative impact on nursing requirements. An increase in HMO enrollment from a 1972 level of 2.4 percent of the population to a 1985 level of 10.6 percent is estimated to decrease the requirements for RNs by about 2 percent.

In addition a synergistic relationship, largely between national health insurance and role reformulation, results in estimates of growth in requirements different from those projected in individual analyses. In the extreme case, the interaction of NHI and role reformulation results in an estimated increase in requirements of 53 percent over the projection period. This situation represents a requirement of nearly 1½ million full-time equivalent nursing positions, and would be the result of implementing a universal national health insurance plan with free benefits and an extensive acceptance of all the role reformulation concepts examined. It appears unlikely this dramatic increase in requirements could be realized, since the limitations on the supply of health care resources would moderate consumer demands, and moderate the reformulation of nursing roles before such a level of requirements could be realized.

In examining these impacts it is important to note that the estimated growth in RN requirements over the projection period (1972–1985) is approximately 145 percent. That is, the estimated number of full-time equivalent (FTE) nurses required in 1985 is 1,003,000, whereas the 1972 employment was about 693,000 FTE RNs.[11] This represents a slight decrease in the RN employment growth rate during an equivalent historical period (1959–1972) in which FTE employment grew 151 percent [American Nurses' Association, 1974].

Because of the magnitude of the anticipated growth in RN employment, the above impacts are best stated in relation to this growth. That is, the 14-percent increase that might occur as a consequence of national health insurance represents an increase in the projected growth of RN requirements from 145 percent to 169 percent. Thus, most of the results in the report are presented in this manner.

Overall, preliminary comparisons of the results of this study with available supply estimates indicate no alarming imbalances in the near future. However, depending on the passage of NHI and the increasing adoption of role reformulation concepts, modest imbalances may develop in the long run, late in the projection period. More urgent, though, is the need for a means to cope with a sudden and dramatic increase in nursing requirements with limited prior warning (e.g., as might be expected under an NHI program). Also, because of substantial variations and uncertainties in estimates of both requirements and supply, we feel a flexible decision methodology is needed to aid in the planning for potential Federal interventions.

[11] These numbers translate into 1,364,000 and 1,163,000 registered nurses employed if the current proportions of part-time to full-time employment levels remain fixed.

CHAPTER 1

Organization of Report

The report is organized into two parts—a main text and three appendices. The main text is primarily devoted to a discussion of the health system changes and their impacts. The effects of each of the three health system changes on nurse requirements are discussed in chapters 2 through 4. Each chapter describes one of the health system changes in detail, discusses the processes by which it affects the requirements for nurses, and presents and analyzes the quantitative impacts resulting from only that change. Then, chapter 5 presents the impacts of simultaneous health system changes. Chapter 6 contains a synopsis of our results and the conclusions and recommendations we have drawn from them. Throughout the text the reader will be frequently referred to one of the technical appendices for details. In the first such appendix, appendix A, the model itself is defined in broad, functional terms. Parameters of the model, input data, and detailed results are all contained in appendix B. Finally, a bibliography for documents referenced in this report is provided in appendix C.

2. THE EFFECTS OF NATIONAL HEALTH INSURANCE ON REQUIREMENTS FOR NURSES

For decades there have been periodic attempts to supplement or replace private health insurance with some form of national health insurance (NHI). Although attempts at passage of such legislation have foundered in recent years, both because of a troubled economy and because of jurisdictional disputes in Congress [*Congressional Quarterly*, 1976], the potential impact of NHI is sufficiently great and uncertain to warrant continued investigation of its effect on various segments of the health care system.

It is not the purpose of this document to discuss the social desirability of NHI, nor to present in great detail the characteristics of all the bills before Congress. These aspects have been adequately described elsewhere: Davis [1975], American Hospital Association [1976], and Social Security Administration [1976], for example. Rather, this report will summarize four principal NHI bills and then analyze the potential impact of such legislation on nurse requirements. The four plans are designated the Insurers' plan, the Labor plan, the AMA plan, and the AHA or Hospitals' plan after the lobby endorsing the respective bills.[1]

The Insurers' plan is titled "National Health Care Act" and is sponsored by Representative Burleson and Senator McIntyre. It would encourage the voluntary offering by employers of a standard package of health benefits through a system of tax incentives. Participation by employees is voluntary. Individual plans could be purchased by the self-employed. The poor, chronically unemployed, and otherwise uninsurable population would receive benefits from a State plan, which would replace Medicaid. This coverage would be purchased from private insurers through a State insurance pool. Under the basic plan, benefits[2] would be subject to 20-percent coinsurance, $100 deductibles, benefit limits on nursing home and home health services, and a $1,000 catastrophic expense limit. Under the State plan, deductible and catastrophic benefits would be a function of income. Persons 65 and older would continue to receive their primary benefits from Medicare rather than from the Insurers' plan. However, they would be entitled to supplement those benefits through the State insurer's plan.

The Labor Plan is the "Health Security Act" backed by Senator Kennedy and Representative Corman. It would provide essentially unlimited free care without regard to whether the recipient has contributed to the plan and without regard to the personal finances of the recipient. The Government would assume the functions of the private insurance carriers, financing benefits through a combination of payroll taxes and matching general tax revenues. Except for nursing home coverage, benefits would be essentially unlimited. Medicare would be repealed, while Medicaid would be retained to cover services beyond the benefits provided.

The AMA plan is the "Comprehensive Health Care Insurance Act" supported by the Representatives Fulton, Carter, Duncan, and Murphy. In this plan, employers are required to offer and partially finance a standard benefit package, but participation by employees is voluntary. For the unemployed, self-employed, and the elderly desiring supplemental Medicare benefits, there is a program of Federal participation through tax credits. The poor and unemployed pay no premiums. Benefits under the plan would be subject to 20-percent coinsurance with no deductibles, few benefit limits, and an income-related catastrophic expense limit. Medicare and Medicaid would be retained.

[1] There is a fifth plan of an entirely different concept, the Long-Ribicoff Bill, which has a very high deductible and is intended only to cover catastrophic health care costs. This plan has gained some attention, because it is far less costly to the Government than the others. However, it would not appear to have as significant an effect on the overall utilization as the more comprehensive plans. Therefore, the impact of catastrophic insurance plans was not analyzed in the present study.

[2] An insurance plan can typically be described with respect to an insured service as having a deductible, the limit up to which the consumer pays 100 percent of the bill; a coinsurance rate, the fraction of the bill in excess of the deductible paid by the insurance; and a benefit limit, the amount (measured in dollars or units of service) beyond which the consumer is fully responsible for expenses. There may also be an upper limit to the total, cumulative out-of-pocket expenditures required of the consumer, which is designated as catastrophic expense protection.

The Hospitals' plan, the "National Health Care Services Reorganization and Financing Act" or "Ullman Bill," would reorganize the health care delivery system through the concept of local health care corporations (HCCs) to coordinate delivery of health services. Employers would be required to offer and partially finance a standard health benefit package for employees, while the poor and elderly would receive care financed wholly or in part by the Federal Government. Most services would be subject to coinsurance and some benefit limits, but no deductibles. There would be an income-related catastrophic expense limit. The plan would entirely replace Medicare, and federalize the Medicaid program.

Factors Influencing Nurse Requirements

The degree to which any of these national health insurance programs would influence the demand for nurses depends upon the degree to which they would affect the consumption of health services which, in turn, is dependent upon both the degree to which the NHI program affects the net price of care faced by the consumer and the responsiveness of the consumer to this price change. The measure of price used in this analysis is the effective coinsurance rate,[3] defined as the fraction of a consumer's annual medical expenses paid out of pocket. It should be noted that this measure subsumes, but is not equivalent to, all other aspects of price such as deductible, coinsurance rate, and benefit limit. The reason for the measure chosen is the paucity of comprehensive data which describe the extent of current insurance coverage in terms of these less aggregated measures.

In computing the impact of NHI-induced changes in coinsurance rates, the study concentrated on those services in which the potential impact on nurse employment is most significant. These are the short-term general hospital inpatient, outpatient, and physician office settings defined in the model description in the previous section.[4] The impact of NHI in these settings is determined by estimating the NHI-induced price change and then projecting the effect of this change on behavior of health consumers. Since there are no comprehensive data on the extent of insurance benefits in the population, the former factor was derived by estimating the current coinsurance rates from other estimates of health care expenditures and comparing these to coinsurance rates under hypothetical NHI plans. The latter factor, the responsiveness of the consumer to changes in his price of care, was determined from observations of large insured and uninsured populations and from social experiments in which the insurance coverage was changed and the attendant consumers' change in utilization of services observed.[5]

NHI Scenarios for Analysis

In an attempt to encompass the range of reasonable possibilities, three NHI scenarios have been defined. The first of these, referred to as the norm, represents a standard or baseline against which the other two are compared. It is simply a situation in which the health system continues to develop in the directions and at the rates typical of the base year, with no substantial impact from any health system changes.

The other two scenarios are illustrative of the course of the health system under two main types of NHI plans, those which rely on coinsurance rates to limit utilization and those which do not. Plans of the first type (designated as NHI 1) have benefit structures roughly similar to conventional plans, and have the primary philosophy of providing such insurance benefits (i.e., these plans extend health insurance to the currently uninsured). The benefit level provided to the uninsured is assumed to be equivalent to that enjoyed by the presently insured population. This scenario is intended to represent such plans as the AMA plan, Hospitals' plan, or Insurers' plan. The plan of the second type, providing for virtually free and unli-

[3] For convenience this measure will occasionally be referred to as the coinsurance rate. However, this should always be interpreted as effective coinsurance rate.

[4] The impacts of NHI on other settings, while of lower-order significance, are summarized in the last section of this chapter. The potential impacts from other factors not explicitly considered are also discussed in that section.

[5] For a more detailed description of the computation of NHI induced changes on health service demand, see appendix B.

Table 1.—Aggregate scenario characteristics

Services affected by NHI	Fraction of population insured (percent)			Coinsurance rate of insured population (percent)		
	Norm	NHI 1	NHI 2	Norm	NHI 1	NHI 2
Hospital inpatient services	[1]95	100	100	[3]5	5	0
Hospital outpatient and physician office services	[2]55	100	100	[4]27	27	0

[1]See discussion in appendix B.

[2]It is probable (see, for example, Kolodrubetz [1974]) that about half of those with private hospital insurance also have private ambulatory services insurance. Assuming that all publicly insured persons also have coverage for ambulatory services, and that 14 percent of the under 65 population have such coverage (see appendix B) this estimate is derived as follows: 14 percent + .5 × 82 percent = 55 percent.

[3]The overall coinsurance rate is about 10 percent (see Worthington [1975]), but 5 percent are uninsured and pay 100 percent of the bill so that the insured pay X where .95 (X) + .05 (100 percent) = 10 percent and X = 5 percent.

[4]The overall coinsurance rate is 60 percent (see Newhouse, Phelps, and Schwartz [1974]); hence, .55(X) + .45(100 percent) = 60 percent and X = 27 percent.

mited care to all, is intended to represent the NHI bill supported by organized labor. This scenario is designated NHI 2.

The aggregate differences in the insurance coverage between these scenarios are summarized in table 1. As is shown in the table, approximately 95 percent of the population currently has insurance coverage for hospital room and board, surgical procedures, and other inpatient physician services. In contrast, only about 55 percent of the population is covered for physician and ancillary services in hospital outpatient departments.

In addition to these differences in coverage, there are also differences in the level of benefits provided to the inpatient and outpatient settings. NHI 1, for example, would only reduce the price of care to the uninsured population by insuring them at the coinsurance rates experienced by the insured population. NHI 2, on the other hand, would decrease the price of care for the insured population by 5 percent and 27 percent in the inpatient and ambulatory settings, respectively. (For the uninsured population, the price of care under NHI 2 would, of course, decrease by 100 percent.)

This analysis assumed that national health insurance will not reduce the level of insurance benefits currently enjoyed by the insured population (i.e., that NHI would not replace all existing policies). Without this assumption, a NHI plan with a 20-percent coinsurance rate[6] for all services could theoretically increase the price of inpatient services for the presently insured population from 5 percent to 20 percent. This would assume the NHI plan would completely replace all existing policies. Under this situation most of the population would face a greater risk of incurring out-of-pocket inpatient costs than they faced prior to NHI, thus potentially decreasing hospital utilization and probably a subsequent decrease in the need for nurses in this setting.

The likelihood of such a reduction in insurance benefits as a consequence of NHI is somewhat doubtful, since current insurance trends indicate an increased desire for health insurance benefits [Kirzay and Wilson, 1974]. It therefore appears reasonable to assume that those whose current insurance programs are better than the NHI plan would supplement the NHI plan with additional insurance to maintain their present level of protection. This situation is inherently assumed in the case of NHI 1, as is shown in table 1.

NHI Impact in Hospital and Physician Office Settings

To estimate the impact of national health insurance, different methodologies were employed for each of the two NHI scenarios. For NHI 1, it is assumed the uninsured become insured and consume health services at the same rate as those members of their respective cohorts who were previously insured. Therefore, the two factors influencing the increase in service demands under the NHI 1 scenario are the fraction of the popula-

[6]Twenty percent is the nominal coinsurance rate in some such plans (Social Security Administration, 1976 or American Hospital Association, 1976), but there also exist liberal catastrophic ceilings beyond which all of the bill is paid by the plan. Thus, the average effective coinsurance rate is probably less than 20 percent. Also, the coinsurance rate is dependent on income in some plans and thus, for some persons, would be even further reduced.

tion insured and the difference between the insured and uninsured populations' demand for these services. For NHI 2, the change in health consumer behavior was computed directly as a function of the coinsurance changes summarized in table 1, using available data from social experiments (see Heaney and Riedel [1970], and Scitovsky and Snyder [1972]).

Assuming that the effective implementation year for national health insurance would be 1977[7] and that the total impact of NHI would not be realized until 1981, the model was exercised for each of the three NHI scenarios. Figure 2 provides a summary of the results of these model runs.[8] In each case, the impact of a scenario is measured by the amount that nurse requirements at the end of the projection period exceed the base year requirements. Since the norm does not include the effects of NHI, the incremental difference between it and the other scenarios reflects the magnitude of NHI impact.

Overall, in the norm alone, requirements for nurses increase by 145 percent over the base year requirements, while NHI 1 and NHI 2 increase requirements by 152 percent and 169 percent, respectively. Thus, the more conservative of the two prototypical plans would result in a 7-percent increase in nurse requirements over the norm, and the less conservative type results in an increment of 24 percent relative to the base year. This translates into an estimated 49,000 to 166,000 additional FTE RNs requirement in 1985 as a consequence of enactment of one or the other of these plans.

The greatest percent impact is in the ambulatory settings with little or no impact in the inpatient setting. However, it should be noted that, in interpreting these percentages a 10-percent increase in requirements for nurses in the inpatient setting is the equivalent of nearly a 100-percent increase in physician office nurses.

In the inpatient setting, NHI 1 has no significant impact in keeping with our analysis, which showed that nearly the entire population already has insurance for these services.[9] In the hospital outpatient and physician office settings, however, this type of NHI would increase the requirements by 266 percent and 184 percent, respectively, over the base year, or about a 214-percent increase in both ambulatory settings combined. This is the result of an increase of 167 percent in the number of ambulatory visits relative to the base year.

For NHI 2, the less conservative form of NHI, the impact is vastly greater. In the inpatient environment, requirements grow by 155 percent compared to 146 percent for the norm. In the outpatient and physician office environments, the increases are 318 percent and 346 percent, respectively, or about 336 percent in all ambulatory settings. These increases are driven by a 131 percent increase in inpatient and a 232 percent increase in ambulatory services.[10] The utilization increases are, in turn, the results of decreasing average price of care in these settings from 10 percent and 60 percent, respectively, to zero. Overall, this scenario requires 166,000 more full-time equivalent nursing positions in 1985 than the norm.

Figure 2 indicates the projected growth for which one would have to plan to meet requirements under a variety of scenarios. This growth is related to a known quantity, the 1972 work force. In addition to comparing the projected values for a particular scenario to the base year requirements estimates, it is also useful to look at differences between 1985 estimates of alternative scenarios. That is, what is the difference between the number of nurses required in 1985 in the presence and absence of national health insurance? Table 2 provides such a comparison between the norm and each of the NHI scenarios. Values in this table show a difference of 5 percent to 17 percent when the norm results are compared to the NHI 1 and NHI 2 scenario estimates, respectively.

NHI Impact in Other Settings

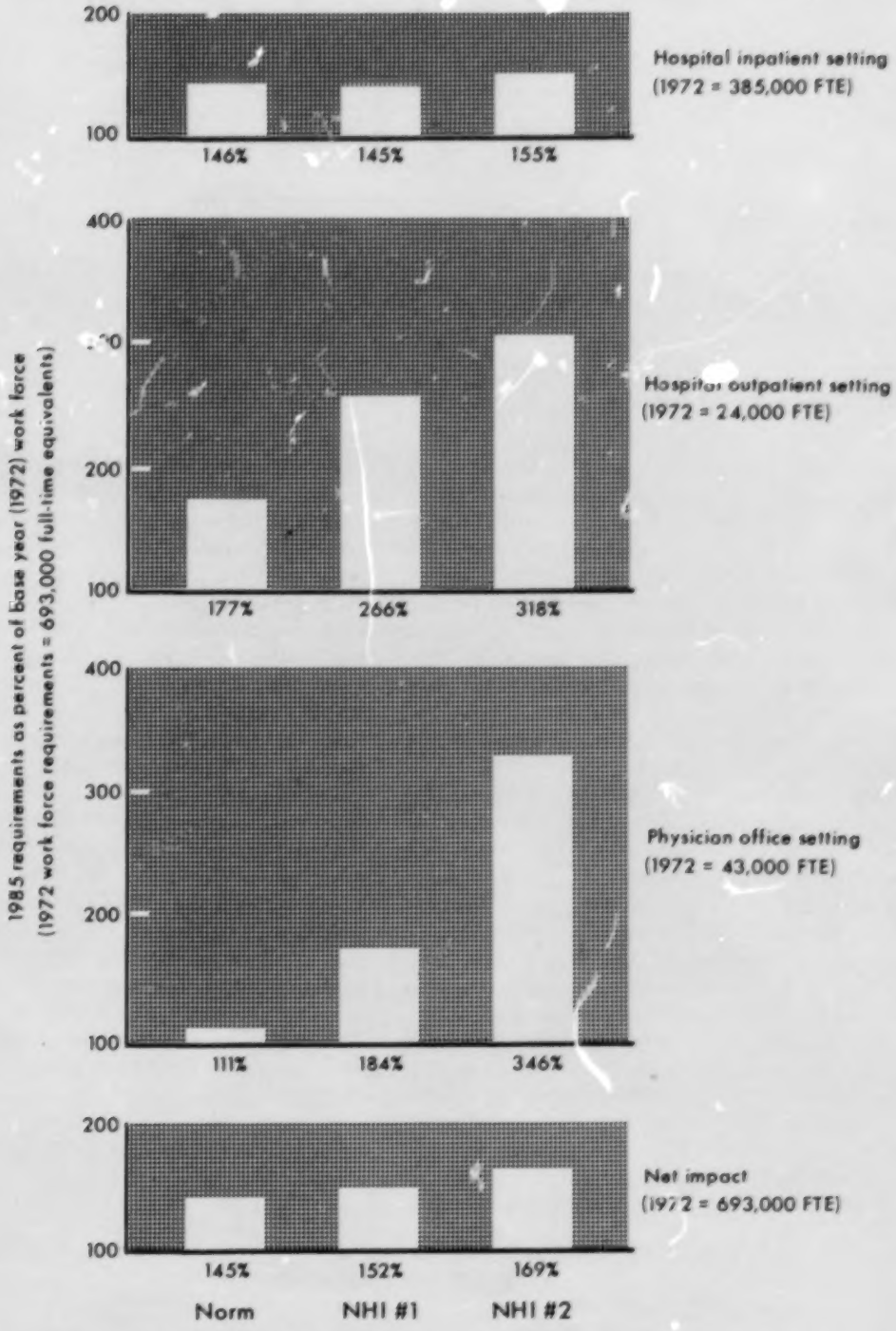
It should be noted that the above-estimated impact only considered three RN practice settings in short-term general hospitals and physician offices. These settings accounted for approximately 65 percent of the FTE 1972 RN work force with most

[7]The actual year of passage is, of course, speculative. It affects the nurse requirements in that year, but not the eventual long-run requirements under a given scenario.

[8]Detailed results of these and other model runs are provided in appendix B.

[9]The slight decrease is attributable to the data that indicate the insured population has slightly lower utilization *per capita* than the uninsured population.

[10]It is probable these potential increases could not be realized because of limitations of supply (e.g., the number of physicians in private practice) or NHI revenue ceilings dictated by the Federal budget.



Norm: No major health system changes.
NHI #1: Extension of conventional health insurance to uninsured.
NHI #2: Complete coverage with nearly free medical care.

Figure 2.—Impact of national health insurance on requirements for registered nurses in 1985

Table 2.—Impact of NHI on 1985 requirements for registered nurses[1]

Health services setting	Impact on health services required (percent)		Impact on nurses required (percent)	
	NHI 1	NHI 2	NHI 1	NHI 2
Hospital inpatient setting	0	+ 7	0	+ 7
Hospital outpatient and physician office setting	+30	+80	+59	+150
Hospital inpatient, outpatient, and physician office settings	0	0	+ 5	+ 17

[1]Impact is measured relative to the requirements projected for 1985 in the norm scenario. This comparison of 1985 projected values is in contrast to figure 2 in which the 1985 values were compared to base year values to illustrate growth. The impact on service requirements for all setting is not provided, since the service demands for individual settings do not have a common measure (e.g., patient days and outpatient visits).

of the remainder employed in other hospitals (9 percent), health (10 percent), and nursing homes (8 percent). It is reasonable to assume NHI would have a lesser effect on the demand for services in other hospitals, since they primarily are either federally funded or provide specialized and/or long-term care. In the case of community health, it is relatively unclear what the impact of NHI might be; however, approximately half of the care provided in this setting is in the areas of school or industrial health nursing, neither of which should be affected by NHI.

The direct effect of NHI on the requirements for nurses in nursing homes should also be relatively small. Although coverage will be increased theoretically from 36 percent[11] of the population to 100 percent, it is a fact that the primary users of nursing home services are already covered largely by a combination of Medicare and Medicaid. Moreover, the benefits offered under most NHI plans will not be extended significantly. That is, current insurance benefits and those proposed under NHI plans are generally valid for 100 days or fewer and are primarily designed to provide for a period of recuperation following a major illness.

However, there are other mechanisms through which NHI legislation may influence the employment of nurses in nursing homes. It is reasonable to expect any NHI program adopted by Congress will contain provisions reflecting the regulatory reform of the nursing home industry being advocated by Congress.[12] However, there is limited agreement as to the appropriate methods to cause these improvements [U.S. Senate, 1974]. One suggested technique is to stipulate the minimum qualifications of a charge nurse to be on duty during each shift. Another is the setting of a minimum staffing ratio, i.e., the ratio of nurses to nursing home residents. The former technique might affect as many as 77 percent of nursing homes (approximately 12,000 homes) by requiring them to employ from one to three additional RNs. If an RN is required to be on duty for all shifts, the resulting requirement for 12,000 to 36,000 additional RNs would increase the 1972 FTE RN labor force by 2 to 5 percent. The latter technique has already been instituted in Connecticut. If used as a Federal prototype, it could produce a minimum requirement for about 80,000 FTE RNs in nursing homes. This would be approximately 30,000 more than were employed in 1972 or about 4 percent of the 1972 labor force. As these calculations indicate, such regulatory reforms could cause the foregoing estimated NHI impacts to be somewhat understated.

Other Considerations

It should also be noted that there are a number of other factors that could possibly contribute to variations in the previous estimates of NHI impact. Among these are the assumption that one type of care will not be substituted for another and the fact that deductible provisions of NHI legislation are not explicitly treated.

The substitution of outpatient for inpatient care

[11]Twenty-two percent of the population in the base year had private nursing home coverage [Mueller, 1974], assuming no overlap with the approximate 14 percent of the population covered by Medicare and Medicaid.

[12]This interest is reflected by the results of the Moss Subcommittee on Long-Term Care and dozens of bills dealing with nursing home reform [Bowman, 1975].

has been noted to occur naturally when the price of outpatient care is reduced relative to inpatient care [Davis and Russell, 1972] and is most notable in prepaid insurance (HMO-type) situations (see chapter 3). Although this is an intuitively appealing notion, several experimental studies have failed to prove its existence [Lewis and Kearnes, 1970, and Hill and Veney, 1970]. In fact, increases in inpatient utilization have sometimes resulted [Kelly, 1965, and Roemer, 1958], possibly caused by the discovery of previously undetected disease through increased screening of ambulatory patients. Explanations of the inconsistency of these results with those for prepaid plans often cite the adverse selection principle, which holds that the people who elect to join an HMO are less likely to utilize inpatient care anyway. In any case, the substitution of outpatient for inpatient care would have limited effect on RN requirements unless it occurred in large proportions, in which case the requirements for nurses would probably be reduced.

The previous analysis did not consider the degree to which various deductible provisions in NHI plans (as opposed to an estimated effective coinsurance rate) could influence the demand for services. The use of the effective coinsurance rate is accurate for those NHI programs that do not have deductible features. Some plans (e.g., the Insurers' plan) do, however, feature small deductibles (e.g., $100 per person per year) while others (e.g., the Long-Ribicoff "catastrophic" plan) feature very large deductibles. A small deductible would tend to affect hospital inpatient demands relatively little. For example, a person with a small deductible considering hospitalization at an average cost of $200 per day is not likely to behave much differently from a person with first-dollar coverage. The effect of a large deductible, however, would probably be to decrease hospital utilization. The extent of this effect would be relatively small, somewhere between the estimated impacts of the scenarios analyzed in the previous section. That is, it would be less than the 7 percent difference between the norm and NHI 2 which has no deductible (see table 2).

In the case of ambulatory care, however, it could be argued (see Newhouse, Phelps and Schwartz, [1974]) that deductibles of a small magnitude could significantly affect consumer behavior because of their proximity to the annual amount of a typical year's expenses for a consumer. Alternatively, it can also be argued that the average consumer is not sufficiently aware of his insurance coverage to modify his behavior at all. In either case, there is no empirical basis for estimating the point at which a deductible becomes significant in ambulatory settings. If significant, however, the previous estimate of NHI impact on RN requirements in physician offices and hospital outpatient clinics is clearly overstated.

In addition, the previous estimates may overstate the effect of NHI by not explicitly providing for improvements in private insurance coverage. That is, the foregoing results assume the price change effected by NHI will be of the same magnitude in the implementation year as it was in the base year. An analysis of the limited existing data (see appendix B) shows that if previous trends continue, the average coinsurance rate for ambulatory services may actually be about 45 percent instead of 60 percent by 1979. If one assumes it is the level of coverage and not the type of insurer (public versus private) that affects the demands for services, then the net requirements in 1985 under NHI will remain as already projected (see appendix B). However, the change in requirements over the projection period would be attributed to both NHI and increased private insurance coverage rather than simply NHI alone.

A third factor potentially causing an overestimate of NHI impact, particularly in the ambulatory settings, is the neglect of the cost of time to the health consumer. This is attributable to the basic assumption of a perfectly elastic supply system. In reality, however, both waiting time and travel time are known to be significant discouraging factors in ambulatory service utilization [Acton, 1973, Simon and Smith, 1973, and Weiss and Greenlick, 1970]. With the profound increases in ambulatory demands generated by NHI, as modeled here, there are bound to be significant increases in the "time price" paid by the consumer. The net result should moderate the increases in ambulatory service demands projected.

In summary, it seems reasonable to conclude that the previous estimate of a 5-percent to 17-percent range of NHI impact (with a possible 5-percent additional increase, if substantial nursing home reforms are included) is moderate to conservative in nature. However, this analysis assumes NHI impact will not be accompanied by major shifts in the health system such as increased HMO enrollment and reformulation of nursing roles. The analysis of these system changes in combination with NHI is the topic of chapter 5.

3. THE EFFECTS OF HMO ENROLLMENT ON REQUIREMENTS FOR NURSES

The health maintenance organization (HMO) represents both an alternate financing structure for health care and a change in the structure of the conventional health care delivery system. While appearing in a variety of organizational structures and under many names (comprehensive health service systems, prepaid group practices, etc.), HMOs all have two common features as recognized by the Health Maintenance Organization Act of 1973. One of these is the enrollees of an HMO are provided with a comprehensive range of services usually including diagnostic, therapeutic, and preventive care. The other common feature of HMOs is their services are financed by charging each enrollee a fixed subscription price to be paid in advance.

The prepaid financing mechanisms lead to changes in the methods employed to deliver health care. Since the HMO must operate on a fixed, prepaid budget, it must control its costs. The manifestation of this motivating factor is generally a significant drop in the utilization of hospital services. Enrollees are hospitalized less frequently for minor surgery, diagnostic procedures, accidental injuries, and other conditions which, under a more conventional insurance arrangement, would not be reimbursed without hospitalization.

The ultimate result of this shift of care is to reduce the requirements for nurses in the hospital inpatient setting with an attendant increase in requirements for HMO clinic nurses. Since there is little evidence to suggest that HMO inpatient nursing care is substantially different from that of the remainder of the population, the resultant impact of HMO enrollment on nurse requirements is dependent on the degree to which the increased requirement for nurses in HMO ambulatory clinics compensates for the reduction in hospital nursing care. The following analysis suggests this trade-off results in a minor net decrease in the requirements for nursing personnel with increasing HMO enrollment.

Factors Influencing Nurse Requirements

There are three factors that will affect the estimate of HMO enrollment on future nurse requirements—the rate of HMO enrollment growth, the degree to which the *per capita* demands of HMO enrollees differ from the rest of the population, and differences in the nursing resources used to meet these demands. The following paragraphs provide a brief description of each of these factors and information related to representing their individual effects on nurse requirements. (Appendix B presents a more detailed description of the model parameters associated with these factors.)

Analysis of HMO data shows that the net increase in the number of operational HMOs increased rapidly through 1974, but that the growth stopped abruptly in 1975. Several reasons can be advanced for this change of events. A number of HMOs are experiencing financial difficulties [Lublin, 1975]. These difficulties may have forced some HMOs to close their doors and may have instilled a note of caution into organizations that are contemplating the formulation of an HMO. Also, recent State and Federal investigations into abuses of the Medi-Cal program (whereby Medicaid patients are specifically allowed to belong to prepaid health plans in California) may be prompting some organizations to wait until it becomes clear what types of regulations will be adopted [Wetherville and Nordby, 1975]. Finally, a number of changes to the 1973 HMO Act to increase incentives for HMO development are under discussion in Congress [Bowman, 1975]. This potential legislative action may have stimulated some organizations to delay HMO implementation in anticipation of a more favorable regulatory and financial atmosphere.

The above conditions would primarily affect the

number of new HMOs that are formulated and become operational in the future, but it may also influence the growth or reduction in enrollment of current HMOs. Since most of the existing HMOs should survive this uncertain climate (particularly those that have been established for a number of years), this analysis assumes that a lower bound on HMO growth would be that which permitted no new HMOs to become operational and all existing HMOs to increase their enrollment at historical rates. Analysis of the growth rates of existing HMOs shows the rate of growth in enrollment (see Wetherville and Nordby [1975]) is dependent on the age of the organization and this dependence essentially follows a negative exponential curve. That is, new HMOs (which have initially a relatively small enrollment) nearly double in size the first year, while those in operation from 2 to 4 years experience annual growth rates of approximately 30 percent and 7 percent, respectively. Thus, if no new HMOs become operational, the average growth in HMO enrollment rapidly becomes fewer than 10 percent after a few years.

Analysis of the second of the above factors influencing the impact of HMOs on nurse requirements, the difference between enrollee and nonenrollee consumption of services, showed the following. First, persons in HMOs utilize about half as many hospital inpatient services per capita as members of the general population (see appendix B) and about three-fourths of the quantity of ambulatory visits *per capita*. Thus, increases in HMO enrollment will result in a decrease[1] in inpatient days and subsequently in nurse requirements in the inpatient setting. Also, since HMOs provide ambulatory services in clinics run by the organization, we assume enrollees will seek ambulatory care in those clinics rather than in the more traditional physician office or outpatient settings. An increase in HMO enrollment, therefore, reduces requirements for nurses in the hospital inpatient, hospital outpatient, and physician office settings while increasing requirements for HMO clinic nurses.

The third major process by which HMO growth can influence overall requirements for nurses is by differences in the intensity of nursing services between HMO and non-HMO environments. In the hospital inpatient setting, there are practically no data on the intensity of nursing services in HMOs, but our analysis of the available data indicated there was insufficient justification for assuming a difference in nursing intensities in this setting.[2] However, there was ample justification for special treatment of the HMO ambulatory clinic setting; so a separate model setting was provided. Analysis of detailed data on several HMOs [Gorby and Associates, 1974], showed the average number of nurses per ambulatory visit in the base year was higher by nearly one-third in HMO clinics. Since ambulatory utilization *per capita* is smaller in HMOs, as we have mentioned earlier, it is evident that, other factors remaining equal, an increase in HMO enrollments will result in little or no net change in requirements for nurses to provide ambulatory care. In other health service settings, no data exist with which to postulate a difference in intensity of nursing services between HMO and non-HMO facilities.

HMO Scenarios for Analysis

Three scenarios of HMO enrollment growth (low, average, and high) were postulated for analysis. The average growth scenario assumed the rate of increase in the number of new HMOs will be the same as the average rate experienced in the 1974–75 time period (approximately 34 new HMOs each year). The low scenario is based on an analysis of HMO enrollment data which shows that the number of operational HMOs increased rapidly through 1974, but that the growth stopped abruptly in 1975 (see appendix B). The low scenario thus presumes no new HMOs will form but existing ones will continue to grow at rates determined by historical data so that about 6.7 percent of the population becomes enrolled by 1985. In the high growth scenario, it is basically

[1]This decrease may not be fully observable because many HMOs contract for inpatient services in local hospitals rather than operate their own facilities. Thus, in a community in which HMO enrollments are increasing, the inpatient utilization may not decline in proportion because of the hospitals' desire to maintain occupancy at efficient levels. Thus, hospitalization in discretionary cases in the non-HMO population may actually increase.

[2]This assumption introduces almost no error for three reasons. First, HMO enrollments are and will continue to be only a small fraction of the U.S. population as we have discussed. Second, the quantity of inpatient services utilized by HMO enrollees is much smaller *per capita* than non-HMO enrollees. Finally, many HMOs do not control their own hospitals anyway, but contract for inpatient services from non-HMO facilities.

assumed that changes to the 1973 HMO Act resulting in a high rate of HMO growth will be made. This analysis assumes that the HMO formulation rate (approximately 65 per year) of 1975 will continue, and all of these HMOs will become operational and grow at an age-dependent rate. Under this condition nearly 10.6 percent of the population will be enrolled in HMOs by 1985.

Thus, even though the analysis assumes a fairly dramatic difference in the number of new HMOs (from none to 65 per year) the model predicts a limited difference in HMO enrollment growth (i.e., from 2.4 percent of the population in 1972 to 6.7 percent or 10.6 percent of the 1985 population under the low and high growth scenarios, respectively). The magnitude of this difference, plus the fact that a trade-off exists between increased RN employment in HMO ambulatory clinics and decreased employment in the hospital inpatient setting, results in a minor net decrease in the requirements for RNs with increased HMO enrollment, as noted below.

Impact of HMO Enrollment

The model results shown in figure 3 support the above observations that an increase in HMO enrollment substitutes employment of nurses in hospitals for employment in HMO clinics. In the hospital and physician office settings, the requirements decline from 144 percent of base year requirements to 140 percent between the low and high growth scenarios, respectively (i.e., a difference of only about 18,000 full-time equivalent nurses). This decline is the result of an estimated reduction of 7 million patient days of inpatient care in 1985 if the high HMO growth scenario is postulated rather than the low HMO growth scenario.

Also contributing to this decline in requirements is the model assumption that HMO enrollees obtain their ambulatory services entirely from HMO ambulatory clinics rather than from hospital outpatient clinics or physician offices as we have defined them. Thus, nearly 54 million fewer visits are realized in these latter settings in the high growth scenario than in the low growth scenario. However, because of slight increases in average nursing intensity in non-HMO ambulatory care, relative to nursing intensity in HMO ambulatory clinics, the differences in utilization and nursing intensity do not compensate as expected.

The net result of the shifts in focus of ambulatory care is that 565 percent more nurses are required in HMO clinics in 1985 than in the base year for the high growth situation, while only 359 percent more are required in the low growth scenario. While these are substantial percentage increases in either case, they represent a difference of only 3,500 full-time equivalent nurses.

Overall, 143 percent more nurses are required in 1985 under the high growth scenario, while 145 percent more are required under the low growth scenario. Thus, if the number of operational HMOs increased by 780[3] over the 1974–1985 period, the nation would require about 15,000 fewer RNs in 1985 than it would if there were no new HMOs formed at all since 1974 (the low growth scenario). This represents about a 2-percent range in the projected RN requirements for 1985, a figure which is probably less than the variability inherent in the model projections.

[3]There were approximately 181 total operational HMOs in July 1975 [Wetherville and Nordby, 1975]. The increase of 780 represents 65 new HMOs per year for 12 years.

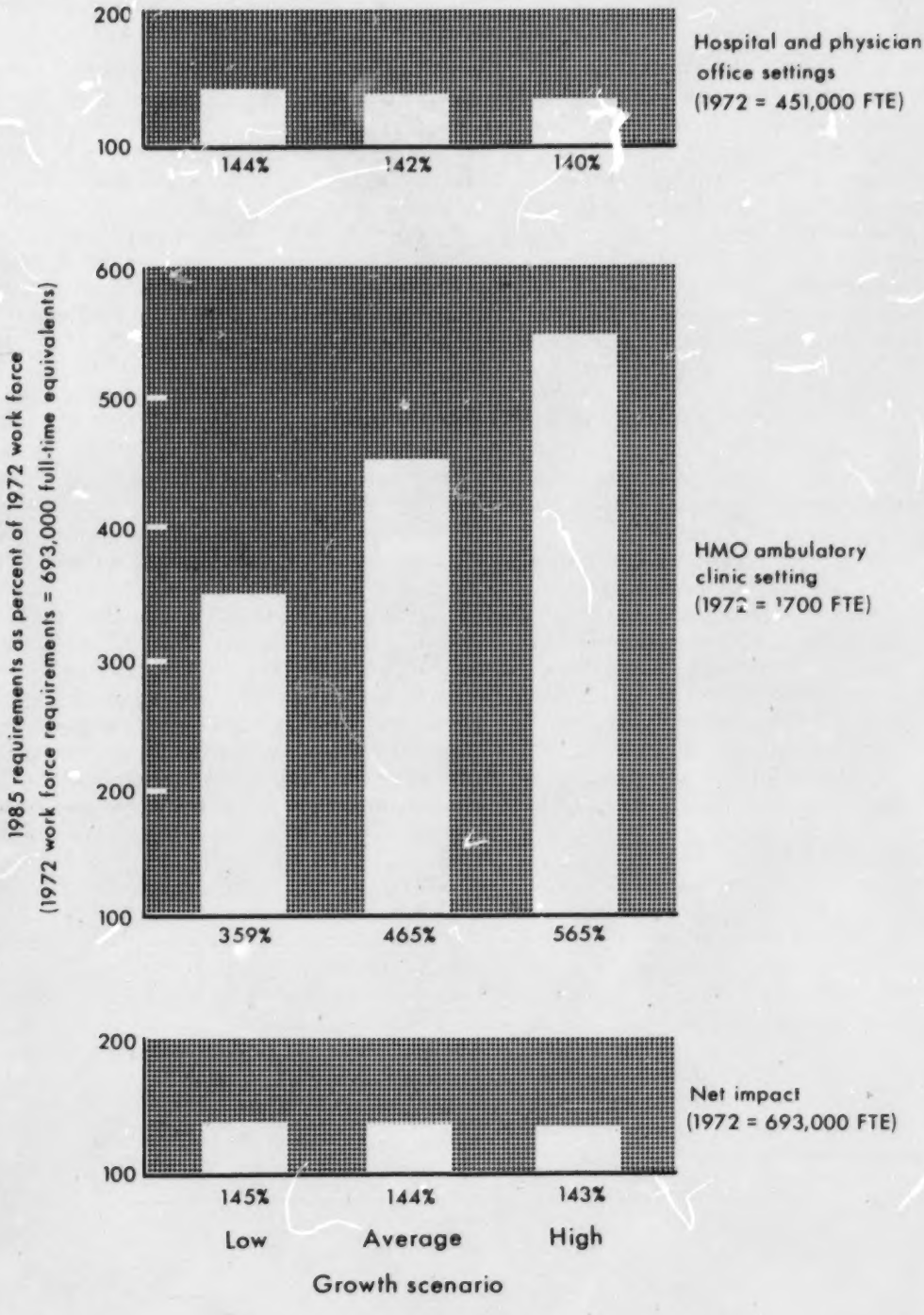


Figure 3.—Impact of growth in HMO enrollments on requirements for registered nurses in 1985

4. THE EFFECT OF ROLE REFORMULATION ON REQUIREMENTS FOR NURSES

The role of the nurse in the health care system has always been evolutionary, generally increasing in level of skill, responsibility, and scope. In recent years, however, concern over the maldistribution of health care personnel, the spiraling costs of health care, and recognition of a need for more effective use of nursing resources has spawned new efforts to reformulate the roles of nurses. Through the expansion of existing roles and the creation of new ones, role reformulation could easily increase the requirements for RNs in 1985.

There are at least two practice settings[1] in which the potential effects of role reformulation could influence RN requirements. In the hospital inpatient setting, increased requirements for RNs could result either from large-scale adoption of the primary nursing (PN) concepts[2] or from an expansion of clinical nurse specialist (CNS)[3] roles into new areas of nursing care. Reformulation of nursing roles in the physician office setting appears possible as a consequence of utilization of nurse extender or practitioner personnel in this setting.

Factors Influencing Nurse Requirements

This section discusses the role reformulation factors that could influence nurse requirements in the hospital inpatient and physician office settings. Each of the three types of reformulation noted above are discussed separately. For convenience, the sections are labeled primary nursing, clinical nurse specialists, and nurse practitioners to differentiate the types of reformulation.

Primary Nursing

In the hospital inpatient units employing primary nursing, one nurse assumes responsibility for all of the nursing needs of a small number of patients (typically three to six in an intermediate care unit) on each shift. A primary nurse gives total care to her patients while on duty and plans these patients' 24-hour care throughout their hospital stay [Marram, Schlegel, and Davis, 1974]. Primary nursing was conceived and implemented by Marie Manthey at the University of Minnesota Hospital around 1970. Since then, a number of hospitals, including Sparrow Hospital, Lansing, Michigan [Hawkins, 1975]; VA Hospital, El Paso, Texas [Daeffler, 1975b]; Childrens' Hospital National Medical Center, District of Columbia [Felton, 1972]; and Merrit Hospital, Oakland, California [Marram, Schlegel, and Davis, 1974] have instituted various versions of this system. The advantages of primary nursing (as reported in the literature) included reduced staff turnover [Cisbe, 1974], increased patient satisfaction [Daeffler, 1975a and Marram, Schlegel, and Davis, 1974], and increased quality of care provided [Daeffler, 1975a].

For estimating future RN requirements, the most significant impact of primary nursing is that staffing patterns of many units change upon adoption of primary nursing. Some units will use only RNs for all nursing functions. In these, requirements for RNs increase, while requirements for other types of nursing personnel (LPNs and aides) decrease. Other units employing the primary nursing concept may use a mixture of RNs, LPNs and aides, but RN/aide and LPN/aide ratios generally are increased as a consequence of adopting this system. Thus, if the number of hospitals using

[1] There are other areas where role reformulation clearly exists (e.g., the nurse practitioner in solo practice); however, the impact of these new or expanded roles on the requirements for RNs in 1985 did not appear to be of sufficient magnitude to warrant detailed treatment.

[2] In the hospital inpatient units employing primary nursing, one nurse assumes responsibility for all of the nursing needs of a small number of patients (typically three to six in an intermediate care unit) on each shift.

[3] Clinical nurse specialist is defined to be a nurse with a master's degree whose primary functional purpose is research or advanced clinical practice rather than teaching or administration.

this concept increases, the result is an increased requirement for RN personnel at the expense of a reduction in the requirements for less skilled nursing personnel.[4]

There are essentially three factors or parameters which determine the degree to which expanded use of the primary nursing concept influences the requirement for nurses. First and second are the fraction of hospital inpatient units adopting this system and the fraction of these units which solely employ registered nurses versus those which employ some mix of nursing resources. Third, the magnitude of the impact depends on the productivity of RNs versus LPNs and aides (e.g., the number of aides which can be "replaced" by one RN). Since there are virtually no data on which to estimate the values of the former two parameters, a reasonable range of values, including an upper and a lower bound, were used in this analysis (see appendix B). In the case of the third parameter, two alternative replacement ratios were investigated, one based on the relative salaries of RNs, LPNs and aides, and the other based on the supposition that these categories of personnel were interchangeable on a one-for-one basis. Since the former technique has economic rationale and appears to approximate more closely that considered reasonable by persons implementing primary nursing systems [Hawkins, 1975], it was the approach used throughout this analysis.

Clinical Nurse Specialists

In addition to primary nursing, another major role reformulation in the inpatient units potentially influencing RN requirements is the creation of new roles for the clinical nurse specialist. Since a clinical nurse specialist is an RN with additional training, increasing the supply of CNSs depletes the stock of active RNs, if the roles of CNSs and RNs do not completely overlap. That is, clinical nurse specialist activities which expand the scope of nursing practice in inpatient care (i.e., perform a service which was previously unavailable to the patient) create an increase in the requirements for nurses in inpatient care. The magnitude of this increase is directly proportional to the increase in the amount of new services offered as measured by the amount of personnel resources to provide these services.

The degree to which the use of clinical nurse specialists in expanded roles influence nursing personnel requirements is, therefore, dependent on the proportional amount of time new specialists spend in expanded roles. Since the total amount of new specialist time available is primarily constrained by the number of graduates in this area, the estimated annual impact on requirements for nurses is proportional to the annual number of CNS graduates. Specifically, the number of nurses required will be that fraction of graduates in clinical nursing specialities who are employed in short-term general hospitals (about 0.30)[5] times the proportion of their time devoted to expanded or new functions (a parameter of the model).

Nurse Practitioners

In the third role reformulation area, the requirements for nurses increase as a consequence of the increasing responsibility of nurses in office practice. This increasing responsibility in performing direct patient care occurs in the light of concomitant changes in public and professional acceptance [Merenstein, *et al.*, 1974] of the nurse as a practitioner and provider of care heretofore the sole domain of the physician. The M.D.-practitioner team has been widely documented as a highly productive and economical one [Spitzer, *et al.*, 1974, and Smith, 1973], based on the conclusion that a nurse with specialized training and a partner M.D. can see more patients and treat them more effectively through combining the appropriate skills of each. Nurse practitioner personnel have evolved in such roles as nurse-midwives [Public Health Service, 1972], pediatric nurse practitioners [Andrews and Yorkover, 1971], and other nurse practitioner specialties.

The number of nurses employed in physician offices in practitioner roles is dependent on physician attitudes toward and the incentives for hiring such personnel. This acceptance is in part influenced by the degree to which a physician can appropriately satisfy the demands for his services. In this analysis, the incentive for employing nurses in this capacity is assumed to be derived from

[4]Clearly, a hospital's adoption of this system does not necessarily require an immediate replacement of LPNs and aides with RNs. Rather, the increase in skill level is achieveable over time as a natural consequence of the relatively high nursing personnel turnover rate experienced by hospitals.

[5]In 1972, 45 percent of these graduates specialized in advanced clinical practice and approximately 66 percent were employed in short-term general hospitals [American Nurses' Association, 1975].

situations in which physicians cannot satisfy the demand for their services. That is, nurses satisfy some portion of the excess demand which cannot be satisfied either by increasing physicians' working hours or by economically employing additional nonprofessional personnel. This approach, although conservative, can result in a dramatic increase in the requirement for nurses in these roles,[6] as is shown below in the discussion on role reformulation. Further, the concept that an excess demand for physician services can be remedied by using nurse practitioner personnel is supported in a number of studies [Henriques, *et al.*, 1974]

Scenarios for Analysis

Although the role reformulation concepts discussed above are not new, they are still in their infancy with regard to the number of nurses employed in such roles. Moreover, reliable national-level data are sparse, and measurable historical trends have not been established. The result of this is that a projection of the future impacts of role reformulation is highly speculative at best, and thus requires a great deal of subjective input.

The "low" scenario is a conservative one. In the hospital inpatient setting, it is assumed the primary nursing concept does not expand measurably (i.e., only 10 percent of all hospital inpatient units employ primary nursing in 1985, and of these only 5 percent employ only RNs). Since the expansion of CNS roles can, at most, increase the requirements for RNs by about 1,500 positions (under current model assumptions) this "low" scenario presumes 50 percent of the activities performed by specialists in 1985 were not performed in the base year (1972). Similarly, the degree to which nurse practitioner personnel are employed in physician offices is limited to that which would satisfy 35 percent of the excess demand for physician services. The "high" scenario on the other hand represents a situation in which there is nearly universal acceptance of all the role reformulation concepts studied. Under this scenario, about 80 percent of all inpatient units would employ the primary nursing concept[7] and all uses of clinical nurse specialists would be in new roles by 1985. In addition, all requirements for practitioner personnel in physician offices will be filled by nurse practitioner personnel. In between these extremes is the "moderate" growth scenario, representing a best estimate of the most likely future scenario. (A more quantitative definition of these scenarios is given in appendix B.) In each of the scenarios, the impact from the other health system changes under study is minimized. That is, a national health insurance program would not exist, and HMO enrollment is only slightly greater than 1972 levels.[8] The results presented in the next subsection demonstrate the impact of role reformulation alone on requirements for nurses under each of these scenarios.

Impact of Role Reformulation

The role reformulation scenarios just described result in the nurse requirements summarized in figure 4. The 1985 requirements are expressed as a percentage of the 1972 work force in full-time equivalent positions. The two most significantly affected settings, hospital inpatient and physician office, are shown separately in the top two charts, while the net overall impact on all settings is shown in the bottom chart.

For the three scenarios, the most significant impact is clearly in the hospital inpatient setting. With limited acceptance of role reformulation in this setting, requirements for RNs in 1985 are nearly 1.5 times (i.e., 148 percent) of the 1972 employment levels. This growth is slightly higher than that predicted in the normative ("norm") case for national health insurance. This slight difference is attributable to the fact that the "low" role reformulation scenario permits greater, albeit limited, utilization of nurses in new roles than does the NHI norm scenario. With nearly univer-

[6] Many of these roles are being filled by nurse practitioners (RNs with additional specialized training of 3 to 12 months). However, RNs with baccalaureate degrees and those trained as clinical nursing specialists also serve in such roles.

[7] The period of time for a large fraction of hospital inpatient units to adopt primary nursing is highly speculative. However, if the adoption of the team nursing concept is used as a model, then this period should be about 10 years (i.e., the time frame of this analysis).

[8] The slight increase in HMO growth is attributable to a natural growth of existing HMO programs; no new HMOs become operational in any of these scenarios.

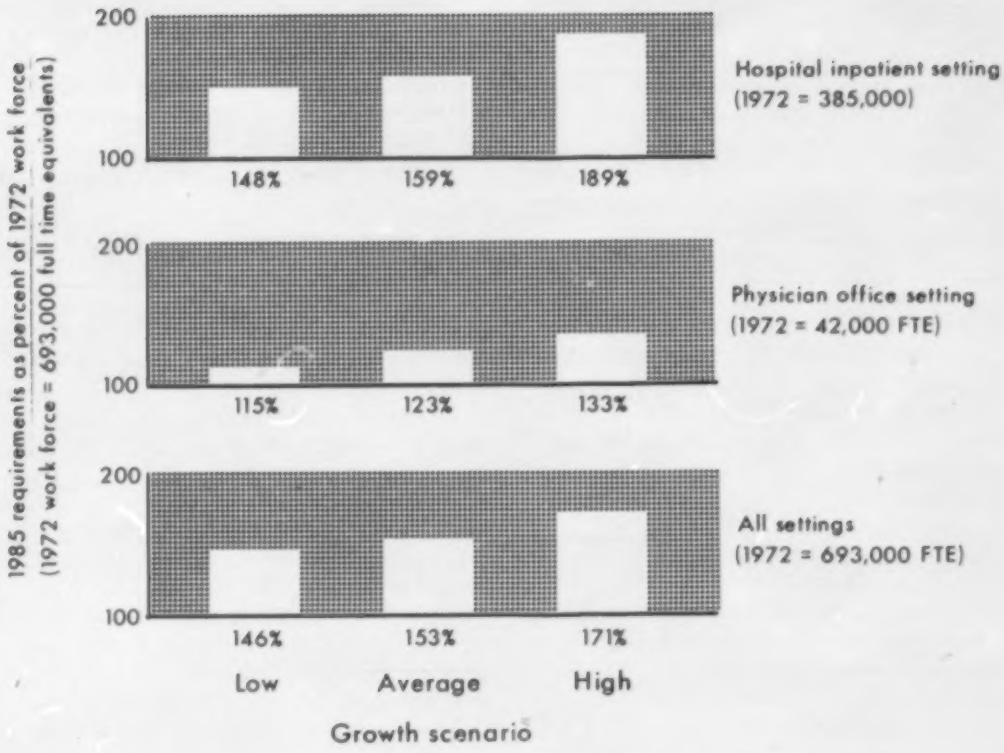


Figure 4.—Impact of role reformulation on requirements for registered nurses in 1985

sal acceptance of role reformulation in the hospital inpatient setting (i.e., 80 percent of hospitals in 1985 employ primary nursing, and every clinical nurse specialist graduating in 1985 performs nursing functions which were nonexistent in 1972), the requirement for nurses in this setting is increased to 189 percent of the 1972 inpatient work force. Thus, the difference in the "low" and "high" scenarios is approximately 159,000 full-time equivalent RNs. This difference is caused almost entirely by the growth of the primary nursing concept. As noted earlier, the number of RNs affected by increased use of clinical nurse specialists is small (less than a 1-percent increase by 1985 even in the high scenario).

In the physician office setting, the use of practitioner personnel increases the 1985 requirements from 115 percent to 133 percent of the 1972 work force, a different of 7,500 full-time equivalent positions. Analysis of the detailed results (appendix B) shows that the estimated requirements for practitioner personnel increase from about 2,500 in the base year to a 1985 requirement of about 4,000 with only low acceptance (i.e., 35 percent of the unmet demand for physicians' services in offices is met by nursing personnel) to about 12,000 with full acceptance (i.e., 100 percent of the unmet demand supplied by nurses). The reason for the relatively low impact in this setting is that the estimated supply of physicians in office practice increases at about the same rate as the estimated increase in demands for these services. Consequently, there is a relatively small number of office visits in which physicians themselves are unable to supply their services.

Overall, role reformulation can affect 1985 requirements to the extent of 146 percent to 171 percent of 1972 requirements. Comparing the 1985 requirements under each scenario, we see the average scenario requires about 5 percent more nurses than the low scenario and about 18 percent more than the high scenario, i.e., full acceptance.

Contrary to the situation observed in the previous chapter, the impact of role reformulation, potentially at least, is reasonably significant. Comparing the total impact of role reformulation as

shown in figure 4 with the corresponding estimate of NHI impact in figure 3, we see the potential increases are on the same order. That is, by itself, NHI could affect 1985 requirements by 5 percent to 17 percent, while role reformulation alone could affect requirements by 5 percent to 18 percent.

Additional Considerations

Whether or not the potential impact calculated above will be realized depends upon a host of factors which must be treated qualitatively at best. In physician offices, for example, the employment of nurses in practitioner roles will be paced by a number of issues, including the acceptability of the idea to physicians, as well as to the physicians' patients, and the relaxation of medical practice regulations imposed by the States. Similarly, the impact in the hospital inpatient setting (which in the above analysis is attributable to widespread acceptance of the primary nursing concept), is highly speculative at best. Primary nursing as a concept is enjoying increased acceptance in that it is being considered, by many of its proponents, as the way of the future. However, whether this concept can or will be adopted by large numbers of hospitals by 1985 is clearly questionable. Further, the above estimates are dependent on the degree to which future adaptations of this concept resemble these current versions of the primary nursing system modeled in this analysis.

5. COMBINED EFFECTS ON REQUIREMENTS

The previous chapters have discussed the individual impact of each of the three health system changes on the future requirements for nurses. It is possible, however, a future scenario could involve a combination of health system changes. Since it is not necessarily the case that the impact of a combination of changes is equivalent to the sum of the impacts of the individual factors, this chapter presents the results of analyzing the impacts of several combinations of health system changes. The combinations of interest were selected because they might reasonably occur, and because they have potential amounts of interactive effects.

Factors Influencing Nurse Requirements

Synergistic effects arise because of the interactions between health system changes. Given that only three system changes are under investigation, only three pair-wise interactions are possible: HMOs and role reformulation, NHI and HMOs, and NHI and role reformulation. Of these, the first two appear to have no significant impact on future nurse manpower requirements. In the case of the first, there exists little evidence to suggest role reformulation is employed differently in HMOs than in the non-HMO portion of the health system. Further, even if this were to be the case, a significant growth in HMOs would have to be paired with a very dramatic reformulation of nursing roles in this setting to alter the previous estimation of the minor HMO impact. In the case of the second interaction, the fact that NHI would be passed relatively late in the projection period (if at all) coupled with the fairly long start-up time required for an HMO would minimize the impact from any new enrollees encouraged by passage of NHI. In any event, the maximum error resulting from this assumption would probably be the decrease in 1985 RN requirements estimated under the maximum HMO growth scenario in chapter 3.

The interaction between NHI and role reformulation is potentially the most significant for two reasons. First, both role reformulation and national health insurance have significant impact on the same health care settings—the short-term hospital inpatient and physician office settings. Second, NHI is capable of producing significant changes in health service utilization, stressing the current system's capability to provide these services in a conventional manner and stimulating the need for nurses in reformulated roles. In physician offices, for example, NHI creates demands for office visits which exceed the ability of the projected physician labor force to supply. In this situation, it is likely that physicians will place greater reliance on personnel in extended roles to increase the quantity of services provided.

Scenarios for Analysis

Three scenarios involving combinations of health system changes have been defined for analysis. To facilitate the analysis, these scenarios are defined in terms of previously defined ones. The first is a conservative situation composed of the more conservative scenarios in each of the three preceding chapters: the "no-NHI" scenario, the low growth scenario for HMO enrollments, and the scenario for low extent of role reformulation. The purpose of this scenario is to provide a conservative estimate of the requirements for nurses in 1985 relative to those in the base year, and to provide a standard against which other combinations can be evaluated. At the other extreme is our less conservative scenario, comprised of the less conservative scenarios for each of three health system changes. This scenario provides estimates of the increases in nurse requirements which probably exceed those that could reasonably be expected. Finally, in-between the other two, is a more moderate scenario consisting of the NHI 1 scenario, moderate growth in HMO enrollment, and moderate degree of role reformulation.

Impact of Combinations of Health System Changes

The three scenarios just defined have widely varying impacts on future requirements for nurses. As shown in figure 5, the increases in requirements from 1972 to 1985 range from 146 percent in the more conservative case to 209 percent in the less conservative case. This represents a difference of approximately 438,000 full-time equivalent RNs, or nearly two-thirds of the 1972 work force.

The results are even more striking when viewed from the perspective of the affected care settings, as summarized in figure 6. In the hospital settings (both inpatient and outpatient) the less conservative scenario has nearly twice the impact as the more conservative scenario, while in the physician office setting the less conservative scenario has almost five times the impact. Substantial increases are also found in the HMO ambulatory clinic setting, but because of the small number of nurses employed in this setting, the impact in real terms is less significant.

The results in the hospital inpatient setting reflect the combined impacts of HMO growth, primary nursing, and national health insurance. In the moderate scenario, for example, NHI 1 alone produced an impact of 145 percent (from figure 2), and moderate growth in role reformulation by itself produced a growth in requirements from 1972 to 1985 of 159 percent. Since the impact of NHI 1 in this setting was not significantly different from the case of no-NHI (i.e., the norm), the 148 percent result of figure 6 is attributable primarily to role reformulation with some slight negative influence from growth in HMO enrollment. In the less conservative scenario, however, the situation is somewhat different. NHI 2 and the high role reformulation scenarios individually resulted in growths of 156 percent and 189 percent, respectively, whereas in combination, they result in a 198-percent increase.

In the hospital outpatient and HMO ambulatory clinic settings, we did not postulate any significant extent of role reformulation. Consequently, the results for these settings closely resemble those in figure 2. Any differences are attributable to a slight negative influence from HMO enrollment growth.

Results in the physician office setting are more striking. In the more conservative scenario, results do not differ significantly from what would be expected. However, in the moderate and less conservative cases, we see startling results. In the former, the 184-percent and 123-percent increases (from figures 2 and 4) caused independently by NHI 1 and moderate role reformation, respectively, are compared to the 211 percent combined impact. In the less conservative case, the equivalent figures are 346 percent and 133 percent, respectively, compared with 580 percent. The reason for the strong interactive effect of NHI and use of nurses in practitioner roles stems from the structure of the physician office submodel (see appendix

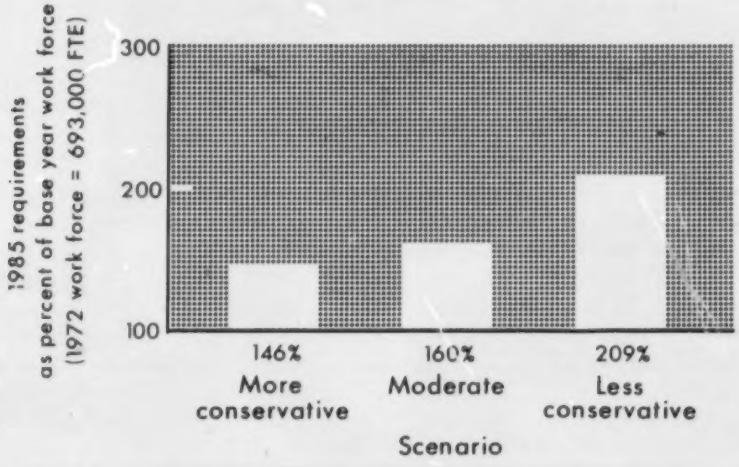


Figure 5.—Impact of multiple health system changes on requirements for registered nurses in 1985 (all settings)

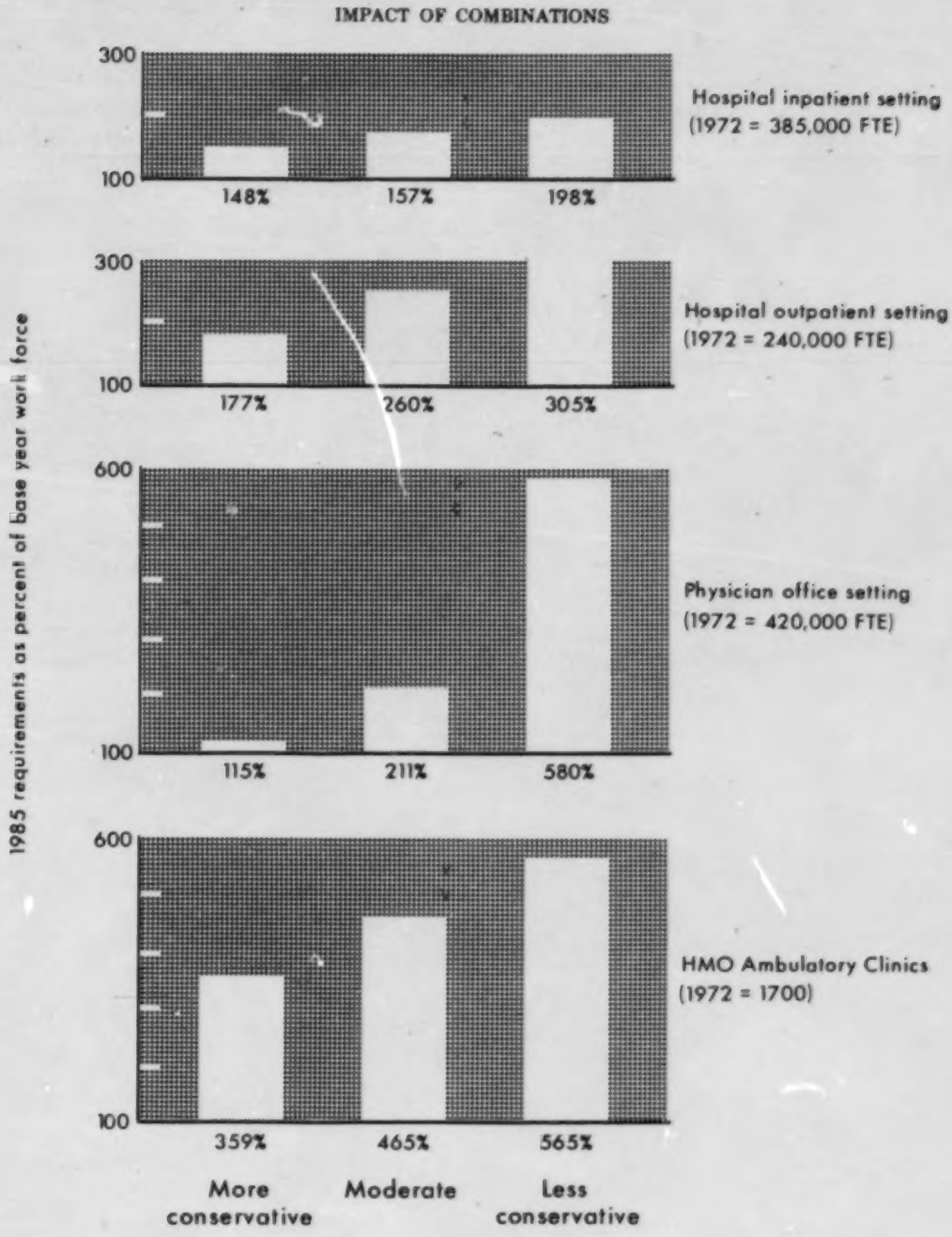


Figure 6.—Impact of multiple health system changes on requirements for registered nurses in 1985

A). The influence of growth in acceptance of nurses in practitioner roles is limited in other scenarios by the rapidly expanding supply of physicians. However, in the combined scenarios, the advent of NHI boosts the demands for ambulatory services beyond the point at which physicians can supply the demand. This creates a backlog of unmet demands for physicians' scervices in offices, a portion of which must be supplied by nurses.

Overall, even the more conservative scenario would increase requirements by 146 percent relative to 1972. Relative to the 1985 requirements

under this scenario, the moderate and less conservative situations would require 10 percent to 43 percent more nurses, respectively. That is, if only the number estimated for the more conservative case were supplied in 1985, there could be a shortage of as much as 43 percent. To supply these requirements, the nurse educator submodel showed increased requirements of 150 percent for nurse educators.[1] However, this would occur only if all of the additional nurses were supplied from new graduates.[2]

[1]See detailed results, appendix B.
[2]This is an assumption of the nurse educator submodel; see appendix B.

6. INTERPRETATION OF RESULTS

Of the individual health system changes studied, future growth in HMO enrollments is the least significant factor determining the requirements for nurses. The most significant potential influences on future nurse requirements are clearly the passage of NHI legislation, which is not under direct control of the nursing profession, and the acceptance of role reformulation, which is at least partially within the capability of nurses to influence.

If neither of these potentially significant system changes occurs, results in previous chapters predict the requirements for nurses in 1985 will be substantially increased from the 1972 base year. That is, our best estimate is there will be a 1985 requirement for nearly half again (i.e., 146 percent) as many nurses as were employed in 1972. Given a conservative type NHI plan and a moderate increase in acceptance of role reformulation, the 1985 requirements would increase this requirement by an additional 14 percent, i.e., 160 percent of the 1972 labor force. This impact translates into a 10-percent incremental increase in the 1985 labor force. At the other extreme, an NHI program with extensive benefit levels combined with a substantial acceptance of role reformulation could result in a doubling (i.e., 209 percent) of the requirements during the 1972 to 1985 time frame. Such an increase translates into a 1985 incremental increase of 43 percent over that predicted in the absence of health system changes.

For proper interpretation of these results, one should bear in mind they are "estimates" and not necessarily predictions of what actually will happen. Further, the 1985 requirements estimates presented in this report are probably subject to at least a 10-percent variation. This stems from the fact that most of the health service utilization data and nurse employment data are ultimately projections themselves based on sample surveys. Assuming such surveys are properly designed to minimize errors caused by poor reporting, poor processing, and nonresponse (a situation not always completely evident), they are still subject to some degree of sampling variability, i.e., variation occurring by chance because only a sample was taken.

Unfortunately, estimates of such errors are seldom published. The exception is the Health Interview Survey [NCHS, 1975b] which estimates that the total hospital inpatient utilization figures are subject to about a 3-percent error, and that the total physician office utilization figures are subject to about 1-percent error.[1] Moreover, the estimates in this report are derived from statistical models based on this data, and the models are themselves subject to error. Even trends obtained from independent sources are subject to variability. For example, the 1985 U.S. population can be forecast no more closely than 2 or 3 percent by the Bureau of Census [1975a].

In view of such factors, 10 percent is the minimum error that can be expected for the total 1985 nurse requirements estimates, with even larger variability being probable in individual settings. Also, in scenarios involving national health insurance, the above error could easily be much greater. While this analysis has used the best data available (see appendix B) to estimate the behavioral response of consumers to NHI, published estimates of the response vary widely. Indeed, many studies estimating the impact of NHI report their results as a parametric function of consumer behavior.

Finally, there is the practical side of accuracy which must be considered, i.e., whether the events assumed to occur will actually happen. Further, will the health system adjust to the changes if they occur in the manner assumed in this analysis? The answers to such questions are not immediately obvious, and could not adequately be resolved without extensive study and research.

In the case of the impact of national health insurance on nursing, it should be noted that the analysis did not consider the potential inflationary effect of NHI on prices or the effects of non-price rationing caused by a sudden influx in demand. However, the additional demands for hospital inpatient services as a consequence of either of the NHI scenarios analyzed would be within the capability of available resources to provide. Thus, the

[1] Actually, these are relative standard errors interpreted as the difference between an estimate based on the survey and one based on a complete census. A difference greater than these would only happen 32 percent of the time.

foregoing projections for increased requirements in this setting should not be affected by our assumption that the utilization of inpatient services will not be supply constrained. In the ambulatory settings, however, the estimated demands for services in either scenario would severely strain the supply system without dramatic changes in the methods of providing these services. Thus, the estimates of the requirements for nurses in these settings may be significantly biased upward. Determination of the extent of this bias requires, however, an integration of the effects of future nurse supply—a sizable research task outside the scope of the current study.

In the case of role reformulation, much depends on the actions taken by the nursing profession itself. That is, the degree to which the estimates of requirements are realized is dependent on the degree to which the profession promotes the acceptance of role reformulation concepts and the degree to which it alters nurse training programs to enable nurses to work in reformulated roles.

Given the results of this analysis and an appreciation of their accuracy, it remains to be determined how they should be interpreted in light of a decision-maker's problem. In other words, How does one use them? One of the primary reasons for analyzing nurse requirements is to assist with decisions regarding the level of Federal intervention necessary to bring supply and requirements into proper balance. If requirements far exceed supply, health needs of the population may go unmet, or perhaps be met at too high a cost. If supply far exceeds requirements, many highly skilled health workers will be unemployed, and those employed may suffer in terms of compensation or working conditions.

Figure 7 shows the results of the three scenarios of chapter 5 compared to recent 1985 supply projections [Bureau of Health Manpower, 1976]. The chief factors influencing the variation in supply estimates were the nurse/teacher wage ratio and the activity rate of the licensed pool of nurses.[2] From the figure, it is apparent our most conservative and moderate requirements estimates fall well within the most conservative and least conservative supply projections. Only the least conservative requirements estimate falls outside the range of potential supply. Nevertheless, if actual supply tends to the conservative side, then the requirements estimates could easily exceed available supply.

To design policy actions to bring such differences into balance, it is necessary to recognize the factors affecting supply as well as to determine the responsiveness of each of those factors to policy action. Factors affecting the entrance of nurses into the labor force are the graduation rates from training programs, the activation rate of already trained nurses from the licensed but unemployed pool of nurses, the reactivation rate of nurses who had allowed their licenses to expire, and the inflow of foreign-trained nurses. Nurses leave the labor force from a variety of causes including death, immigrations, changes in career preference, changes in family status, etc. Of these factors, the most significant one amenable to Federal intervention is the educational process producing new graduates. This process can be modified through federally funded training programs, scholarships, loans, grants, and other activities.

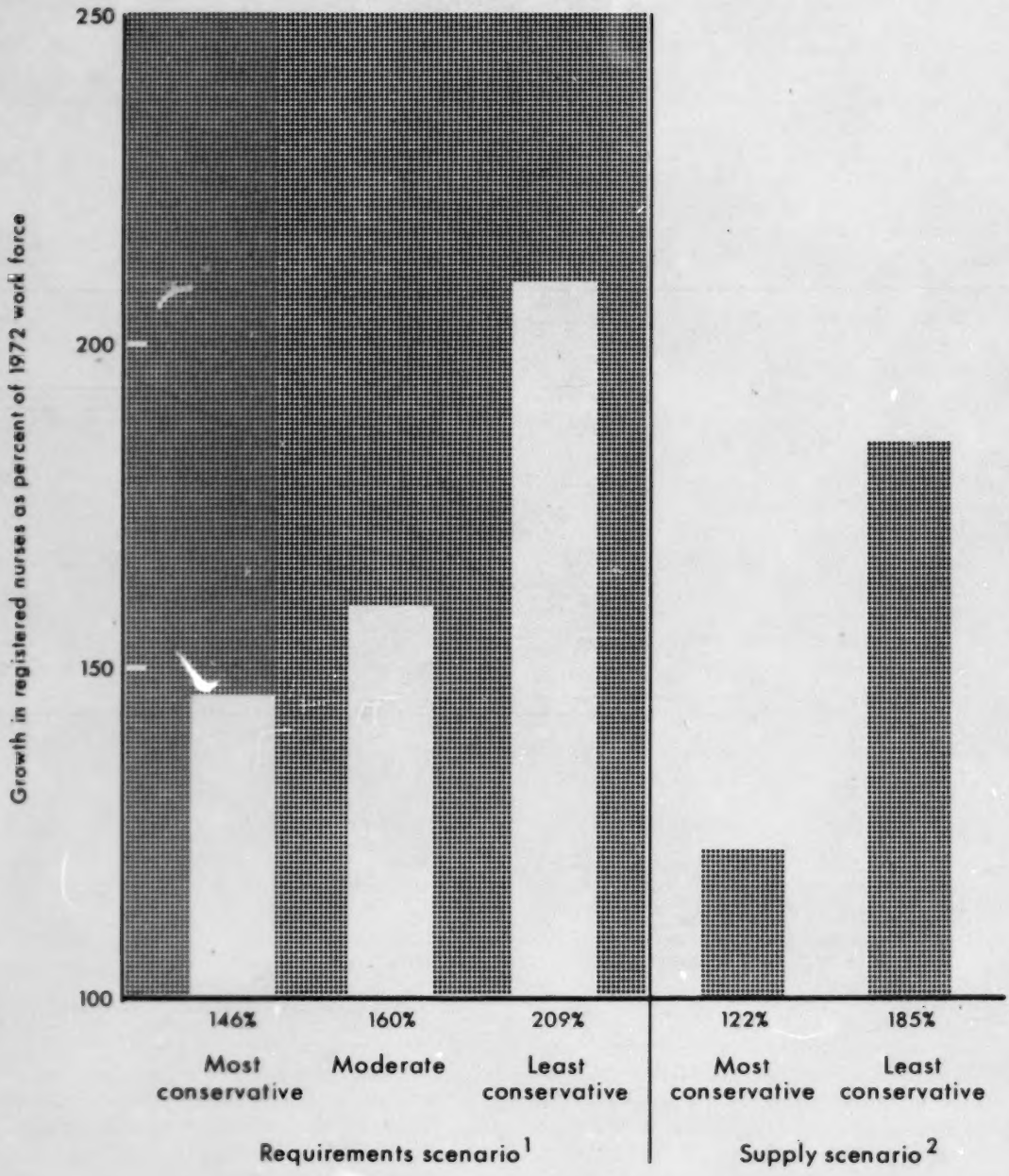
To determine how the flow of new graduates and other factors should be adjusted to bring requirements and supply into balance, it is necessary to determine both the numerical difference between requirements and supply, and the variation of this difference over time. The first factor determines "how much" action should be taken and the second factor determines "when."[3] Thus the planner requires an expression of requirements and supply in terms of the numbers of additional nurses required and supplied over time.

Figure 8 repeats the results from the three scenarios of chapter 6 in terms of the cumulative numbers of additional nurses necessary to meet the projected requirements. Contrasting these results with the numbers of additional nurses supplied to the labor force [Bureau of Health Manpower, 1976], several significant conclusions can be drawn. First, requirements in the conservative to moderate range fall within the moderate region of estimated supplies,[4] indicating that drastic policy changes to balance the two factors are unlikely to be necessary. Second, if one believes that the least conservative requirements estimates are valid, then serious imbalances may occur beginning in 1978 and 1979. The need for urgent policy action to correct such an imbalance is for the most part dependent on the period of increasing demand

[2]Activity rate is the proportion of licensed RNs who are employed.

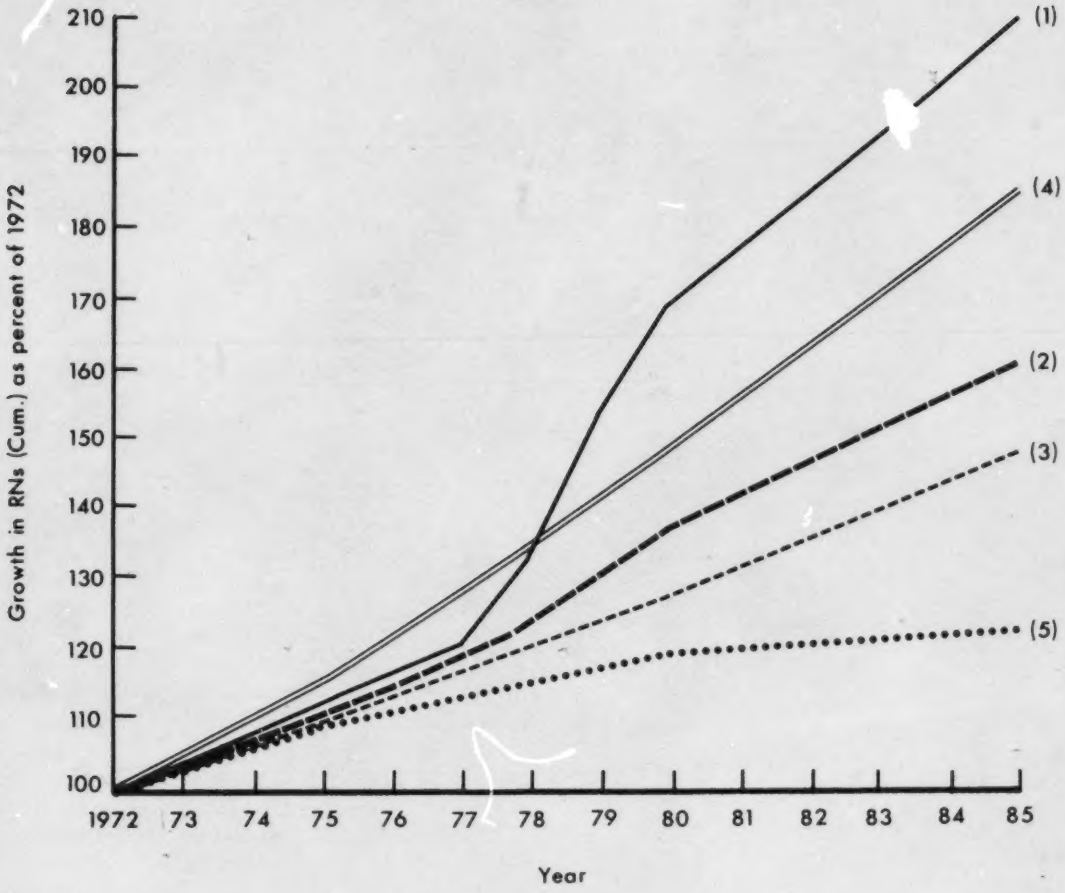
[3]The importance of the time factor stems, of course, from the time lag between policy action and results as observed in the education of new nurses.

[4]This is within the accuracy range wherein either factor can be estimated.



[1]As defined in chapter 6.
[2]From [Bureau of Health Manpower, 1976] page 101, alternatives 1 and 4 assumptions expressed as ratios to 780,000, the total employed in 1972.

Figure 7.—Growth in projected requirements and supply of registered nurses by 1985



Requirements Scenarios:
[1]Least conservative (NHI 2, high role reformulation, high HMO enrollment growth)
[2]Moderate (NHI 1, moderate role reformulation, moderate HMO enrollment growth)
[3]Most conservative (no NHI, little role reformulation, little HMO enrollment growth)
Supply Scenarios:
[4]Least conservative (alternative 4, see figure 7)
[5]Most conservative (alternative 1, see figure 7)

Figure 8.—Projected growth in requirements and supply

for health services resulting from a "free" NHI plan. This transition is currently assumed to be 2 years. If less, the severity of the imbalance would be greater and if more, the difference between supply and requirements would be lessened. In either case, however, it is of sufficient magnitude to question whether traditional methods (i.e., increasing the number of new graduates) is a viable policy action.[5]

[5]Moreover, in the long run, attempting to satisfy the step increase by increasing the graduation rate could result in oversupply.

One alternative to satisfy and large step increases in requirements would be to concentrate on policy actions designed to stimulate the large pool of unlicensed and/or unemployed nurses to participate in the labor force. Since only about 70 percent of the licensed nurses are employed, and since about 80 percent of trained nurses are licensed [Bureau of Health Manpower, 1976], policy actions which significantly increase these percentages could easily alleviate the imbalances shown in fig[illegible].

Appendix A

THE VRI NURSE REQUIREMENTS MODEL

The VRI model predicts requirements for nurses under various health care system scenarios, including various health insurance plans, different levels of HMO enrollment, and different levels of nursing role reformulation. The schematic model structure shown in figure 1 (see page 3) describes the major model components and outlines the conceptual approach employed to assess the future requirements for nurses. Briefly, it is hypothesized that the future requirements for nurses are dependent on three factors: the size and composition of the future population, *per capita* demands for health care services, and the organizational systems used to provide the services demanded. These three factors correspond to the three major modules of the model—the population module, the demand-for-services module, and the nurse manpower requirements module.

Naturally, the complete specification of such a model is dependent upon volumes of detailed data and analyses which are far too extensive to reproduce here in their entirety. Since the main emphasis on the project and in this report has been on the results obtained and their interpretation, the model documentation is presented here in a much abbreviated format. That is, this description concentrates on the inputs and outputs for each submodel, and displays a general symbolic representation[1] of the functional relationship between these quantities. Also, the description indicates the key assumptions, and the ultimate source of the data used to obtain parameter values for the submodel.[2] For each submodel, similar (and usually equivalent in structure) representations were developed for both registered and licensed practical nurses. However, to economize on notation, the equations are shown only in terms of RNs.

The remainder of this appendix provides a description of each of the model components and their respective subcomponents in terms of general analytic structure and key model assumptions.

Population Module

The population module consists of four submodels. The first of these, the population submodel, provides a description of the size and composition of the future U.S. population. The second, the health insurance submodel, is used to describe quantitatively current health insurance coverage as well as that anticipated under alternative national health insurance proposals. The third, the HMO submodel, estimates future HMO enrollment. The output of these three submodels is then integrated in the health consumer submodel to provide a complete characterization of the future population of health consumers. Each of these four submodels is discussed in greater detail in the following subsections.

Population Submodel

The population submodel provides projections of the population characterized by age, sex, income, and family status. The specific population groupings selected correspond to those used by the National Center for Health Statistics to permit use of health service utilization data available from that organization. The projections produced by this submodel are primarily based on data available from the Bureau of Census.[3]

The output of the population submodel is determined as follows:

$$N_{sf}(t) = N_s(t) \quad P_{sf}(1972),$$

[1]This functional form may in actuality represent one or more detailed equations or data matrices.

[2]Intervening steps in processing the data are usually omitted.

[3]This submodel merges Bureau of Census statistics regarding the current income distribution of the population [Bureau of Census, 1975b] with Series 2 Bureau of Census projections of the distribution of age and sex cohorts over time [Bureau of Census, 1975a].

where

$N_{sf}(t)$ = number of individuals in each age/sex/family income/family status group sf in year t;

$N_s(t)$ = Bureau of Census projected populations by age and sex group s in year t;

$P_{sf}(1972)$ = percent of each age/sex group s in selected family income and family status groupings f in 1972;

s = age/sex group (with age groupings of 0-16, 17-24, 25-44, 45-64, 65+); and

f = 1972 family income groupings (<3k, 3k-5k, 5k-7k, 7k-10k, 10k-15k, >15k), and family status (unrelated, in family).

The key assumption of this submodel is that an individual's age and sex dictate his family income and family status, and that this relationship is fixed at its 1972 levels. Although this assumption is, of course, not precisely true, any errors introduced by it are relatively minor.

HMO Submodel

This submodel projects the number of persons enrolled in HMOs, by age and sex, in year t (estimated from 1974).[4] The general form of the model may be summarized as follows:

$$E_s(t) = F_s(t) \cdot \left[E_0(t) + \sum_n (1 + R_n) \cdot E_n(t-1) \right],$$

where

$E_s(t)$ = total number of persons in each age/sex group s enrolled in HMOs in year t;

$F_s(t)$ = fraction of enrollees in each age/sex group s in year t;[5]

$E_0(t)$ = number of enrollees in new HMOs in year t (this is the input to the model and is based on the assumed number of HMOs which will become operational in any year);

$E_n(t)$ = number of enrollees in HMOs which have been operational for n years in year t (for $n > 0$); and

R_n = annual rate of increase in enrollment of HMOs which have been operational for n years and is determined as follows:

$R_n = 1.042_e^{-.695n}$ for $n = 1, 2, 3$.

$R_n = 0.071$ for $n \geq 4$.

$E_n(t)$ is determined from the number of HMOs operational in year t which in turn is projected as a function of a scenario variable indicating the formation rate of HMOs. From analysis of data in Wetherville and Nordby [1975], the rate of growth in enrollment, R_n, of a given HMO is assumed to decline in a negative exponential fashion with the age of the HMO as noted above.[6] Values of a $F_s(t)$ are based on analyses of data from Gorby and Associates [1974], which show a slightly disproportionate age/sex mix of the HMO population relative to the general population.

The Health Insurance Submodel

The health insurance submodel is an empirical model rather than a mathematical one. It "models" a health insurance plan by describing, for each cohort of the population, the fraction eligible for plan benefits for each health care setting. Plans considered are the National Health Insurance plans studied as well as the current insurance coverage. Current insurance coverage is defined as the fraction of a cohort covered regardless of extent of benefits. Thus, for example, if 90 percent of a cohort had any hospital benefits at all, it was assumed that 90 percent of the cohort was "covered" for hospital insurance. There are no reliable data with which to refine this definition to differentiate levels of insurance benefit at the cohort level.

The manner in which specific values were developed for this submodel is discussed in appendix

[4] Actual numbers of HMOs are used through 1974, because data is available for those years [Wetherville and Nordby, 1975]. Formation of HMOs after 1975 is an input variable which establishes the number of HMOs that become operational in any future year. The number of enrollees in new HMOs is assumed to be 2,280. This is based on HMO enrollment data from Gorby and Associates [1974] and the above model of the HMO growth rate, R_n.

[5] The value of this fraction is assumed to be independent of the age of the HMO but depends on the age/sex distribution of the population for each projected year.

[6] It should be noted that this exponential relationship is assumed to be valid for the first 3 years of operation. For HMOs 4 years old and older, the rate is set at 7.1 percent (i.e., the average rate experienced in 1974 by all HMOs operational on or before 1970 [Wetherville and Nordby, 1975]).

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B. The key assumptions, however, are these:

1. Private hospital insurance coverage is as described in Davis [1975];
2. Public hospital insurance coverage is determined as described in appendix B;
3. Insurance coverage for ambulatory services is conditional on having hospital insurance coverage;
4. Population behavior is not significantly misestimated if publicly insured and privately insured are included in the same insurance class; and
5. NHI plans will leave no groups of people uninsured.

The Health Consumer Submodel

The health consumer submodel performs essentially a bookkeeping operation in determining the number of individuals in each age/sex group enrolled in HMOs as a function of time, and in determining the number of non-HMO enrollees having each class of insurance as a function of time. In doing so, several assumptions are made. First, it is assumed the distribution of individuals in HMOs by age and sex follows that observed in Gorby and Associates [1974]. Second, it is assumed the income distribution for HMO enrollees is the same as for the Nation. Finally, it assumes persons in HMOs are not otherwise insured. Any error introduced by these assumptions is relatively small because of the relatively small fraction of the population that are HMO enrollees.

The output of these operations is an empirical characterization of the future United States population, in terms of the type of health insurance coverage offered to individuals in specific age/sex/family income/family status cohorts. The health insurance characterization is distinguished for each of the six health settings of figure 1 and includes no insurance and HMO enrollee designations.

Demand-for-Services Module

This module performs the function of computing the projected demand for health services in each of the six settings shown in figure 1 for each year of the projection period. It does this by applying a large array of *per capita* demands to the numbers of individuals estimated in the population section. For each population cohort (age, sex, family income, family status) and insurance class (insurance type by health setting), the projected population is multiplied by the appropriate projected *per capita* demand for each type of service.[7] Then, these projected service demands are aggregated to produce as output six quantities, the total demands for services by setting, for each year of the projection period. The *per capita* demands may change from year to year depending on input growth parameters. The values for the *per capita* demands and associated growth parameters were determined as appropriate for each user-defined scenario from sources described in appendix B.

The principal assumption behind this submodel is that the behavior of the population in consuming health services is reasonably uniform within the population cohorts of the model. Since the model predicts health service demands at very aggregated levels, i.e., for the Nation, it is unlikely that this assumption introduces significant levels of error. Further, the level of disaggregation used is about the limit achievable with current available data.

The Nurse Requirement Module

In this module, the aggregate health service demands projected in the previous section are translated into requirements for nurses. Also, the model estimates requirements for nurses in those settings which do not rely on projected service demands (e.g., private duty nursing, some community health and educator settings). In addition, this module treats the effect of role reformulation on future RN requirements. Each of the submodels in this module which estimate nurse requirements is discussed individually below.

[7] The health service utilization data for the hospital inpatient, outpatient, and physician office settings were derived from analyses of the 1972 Health Interview Survey data tapes (see National Center for Health Statistics, [1973a] and related data). Nursing home utilization rates were estimated from other National Center for Health Statistics data [1973a and undated-c], while *per capita* demands for home care visits were estimated from other sources [Bureau of Health Manpower, 1975, and Hurtado, Greenlick and Lauvard, 1972].

The Physician Office Submodel

This submodel requires as input the total annual number of physician office visits in the United States in each year of the projection period. The key assumptions of this submodel are that the supply of physicians can be determined, and that the major determinant of nurse employment in physician offices is the ratio of the number of visits demanded in the future to the number of physicians available to provide their services. It has the following general structure:

$$RN_1(t) = \sum_q f_q(t) \cdot N_q(t) \cdot (1+\beta t) P_q ,$$

where

$RN_1(t)$ = number of FTE *RN*s employed in physician offices in year t;
$f_q(t)$ = fraction of FTE nonphysician personnel in physician offices of type q that are *RN*s in year t;[8]
$N_q(t)$ = number of FTE nonphysician personnel employed per physician, determined as a function of the number of visits per physician in private practice type q;
P_q = number of physicians in private practice type q in 1972; and
β = growth rate of number of physicians entering private practice (about 1.5 percent per year[9]).

Physicians are classified by specialty[10] and practice size where practice size is determined by the average number of current office visits per week. The values for $N_q(t)$ were determined by using the production functions developed by Reinhardt [1970],[11] which generally are:

$$V_q(t) = e^{bN_q(t)+dN_q^2(t)+k_q} ,$$

where

$V_q(t)$ = average number of visits demanded per week in private practice type q in year t;
$N_q(t)$ = number of FTE nonphysician employees per physician (noted above);
b and d = estimated coefficient calculated from Reinhardt's original production functions for each practice type; and
kq = constant which provides an estimate of the number of visits a physician can provide without employees in practice type q.

The physician office submodel also determines the effects of role reformulation in this setting. In the physician office, the incentive for role reformulation is assumed to occur when physicians cannot satisfy the demand for their services by increasing their hours or by economically[12] employing additional nonphysician personnel. The remaining unsatisfied visits are assumed to be met by extender personnel, a fraction of whom are nurses. The number of such nurse extender personnel required is determined from:

$$RN_1^*(t) = RN_1(t) + \sum_q r \cdot EPV_q \cdot V_q^*(t) ,$$

where

$RN_1^*(t)$ = number of FTE *RN*s and *RN* extender personnel in physician offices in year t;
$RN_1(t)$ = number of FTE *RN*s in physician offices in year t;
r = fraction of FTE extender personnel (EP) who are nurses; (This variable is specified as an input parameter, since its value depends on many factors, e.g., the future supply of nurse practitioners, the future sup-

[8] Values for this fraction were estimated from data provided in *Profiles of Medical Practice*, 1972 [American Medical Association, various dates]. These values are: 0.171 (general practice), 0.210 (pediatrics), 0.221 (OB/Gyn), 0.147 (medical specialties) and 0.157 (surgical specialties).

[9] Value for β is estimated using 1963–1973 data from American Medical Association [various dates] with 1963–1967 data adjusted to reflect revision in the AMA physician classification scheme.

[10] Five types of office practice treated by the model are: general practice, obstetrics and gynecology, pediatrics, medical specialties, and surgical specialties.

[11] Other production functions of the physician office have been developed, including those by Kimbell [1974] and Kimbell and Lorant [1973]. Since the former uses weekly patient visits (including hospital visits) and the latter employs gross revenue as output measures, neither was used in this analysis. However, another study [Kimbell and Deane, 1974] found the different production functions produced similar results.

[12] The analysis by Reinhardt [1970] indicates that physicians can profitably utilize no more than four nonextender employees. If we assume that physicians have at most four employees, Reinhardt's production function can be used to estimate the number of visits that can (or possibly should) be provided. For example, a general practitioner would provide no more than 220 visits per week in 1972, where the Medical Economics' [1973] survey shows many general practitioners exceeded this limit.

ply of physician's assistants, and changes in physician reimbursement policies, all of which depend on Federal policy actions.)

EPV_q = number of FTE extender personnel employed per visit in type q office practices, which is derived from a number of sources[13] that measure the productivity of extender personnel in physician offices; and

$V_q^*(t)$ = number of physician office visits in year (t) satisfied by nonphysician (extender) personnel. The value of this parameter is dependent on the difference between the number of visits demanded in a type of practice and an estimate of the maximum number of visits a physician can profitably supply without extender personnel.

Hospital Inpatient Submodel

This submodel requires as input the total annual number of short-term hospital days utilized in each year of the projection period. The submodel structure is based on an analysis of historical national data which shows that nurse requirements in this setting are adequately determined as follows:

$$RN_2(t) = RNN + RNIC \cdot IC(t) + RNPD(t) \cdot PD(t),$$

where

$RN_2(t)$ = total number of FTE *RN*s employed in non-Federal short-term hospital inpatient units in year t;

RNN = hospital inpatient FTE *RN*s not employed in the Department of Nursing Service (excluding nursing faculty) in 1972; (This is an empirically derived constant independent of time and workload, since recent data show that *RNN* has remained relatively stable at about 18,000 FTE *RN*s for the period 1968–1972.[14]

$RNIC$ = average number of FTE *RN*s/*ICU* bed;[15]

$IC(t)$ = number of ICU beds in year t;[16]

$RNPD(t)$ = number of FTE *RN*s employed (plus vacancies) in the Department of Nursing Service[17] per patient day in year t; and

$PD(t)$ = number of patient days demanded in year t (calculated in the demand for service module).

This submodel also treats two types of role reformulation which affect the requirements for registered nurses in hospital inpatient units. These are: the institution of the primary nursing concept in hospital inpatient units and the expansion of the clinical nurse specialist role in the hospital.

On units employing primary nursing, one nurse assumes responsibility for all of the nursing needs of a small number of patients (typically three to six in an intermediate care unit) on each shift. These *PN* units use a mixture of *RN*s, *LPN*s, and aides with greater *RN*/aide and *LPN*/aide ratios. This change in nurse manpower mix has the general effect of increasing the requirement for *RN*s as is reflected by the following modification to the hospital inpatient model structure:

$$RN_2^*(t) = RNN + RNIC \cdot IC(t) + f_1(t)\,[RNPD(t) \cdot PD(t)] + [1 - f_1(t)] \cdot [RNPN(t)],$$

where

$RN_2^*(t)$ = number of FTE *RN*s in short-term general hospital inpatient units after expanded use of primary nursing system in year t;

RNN = hospital inpatient FTE *RN*s not employed in the Department of Nursing Service (excluding nursing faculty) in 1972;

$RNIC$ = average number of FTE *RN*s/ICU beds;

$IC(t)$ = number of ICU beds in year t; and

$f_1(t)$ = fraction of hospital inpatient units

[13] See Pondy (1972); Smith, Miller and Golloday (1972); and Schiff, Fraser, and Walters (1969).

[14] Source: *Nursing Personnel in Hospitals*, Bureau of Health Resources Development, various dates.

[15] The value of this parameter is assumed to be slightly less than 1.0 (i.e., assuming one *RN* per five *ICU* beds and that an *ICU* must be staffed 24 hours a day and one FTE registered nurse works 4.5 shifts (8 hours) per week.

[16] Determined from extrapolating a least squares regression line on data in American Hospital Association (various dates), which estimates a doubling of *ICU* beds over 1972–1985.

[17] Adjusted to account for *RN*s in *ICU*s and determined from extrapolating least squares regression lines on historical data (Bureau of Health Resources Development, various dates, and American Hospital Association, various dates).

not adopting primary nursing system in year t (this is a model input variable);

$RNPD(t)$ = number of FTE *RN*s employed (plus vacancies) in the Department of Nursing Service per patient day in year t;

$PD(t)$ = number of patient days in year t;

$RNPN(t)$ = number of FTE *RN*s in hospital inpatient units adopting primary nursing system in year t.[18]

The second major role reformulation calculated in this submodel is the expansion of roles for the clinical nurse specialist (CNS). Nearly all new clinical nurse specialists are active RNs who obtain a master's degree. Consequently an increase in the supply of CNSs results in a concurrent decrease in the number of available active *RN*s and hence an increase in the requirements for *RN*s to fill these vacancies. This increase is minimal if the roles of CNSs and RNs totally overlap, since employment of new CNS graduates could in effect fill these vacancies. Therefore, the increase in *RN* requirements resulting from expansion of CNS roles is dependent on the amount of time new CNS employees spend performing functions not provided previously. The additional requirement for *RN*s as a consequence of this condition is calculated as follows:

$$RN_2(t) = RN_2(t) + f_2 f_3 f_4(t) \cdot RNMS(t),$$

where

$RN_2(t)$ = number of FTE *RN*s in hospital inpatient units with an expansion of clinical nurse roles in year t;

$RN_2(t)$ = number of FTE *RN*s requirements estimated in the hospital inpatient model in year t (note in the case where use of primary nursing in expanding this variable is replaced with $RN_2^*(t)$);

$RNMS(t)$ = nurses with master's degrees in year t;[19]

f_2 = fraction of *RN*s with master's degrees in clinical practice estimated to be 0.45;[20]

f_3 = fraction of nurses with master's degrees entering clinical practice in hospitals, estimated to be 0.66;[20] and

f_4 = fraction of hospital-based nurses with master's degrees who assumed new roles in year t (this is a model input variable).

Hospital Outpatient Submodel

This submodel computes the total number of nurses required in short-term general hospital outpatient and emergency clinics. It requires as input the total annual quantity of visits to such clinics. It is based upon the assumption that nursing intensity in this environment will continue to remain relatively stable, as it has in the recent past.[21] The resultant functional form is:

$$RN_3(t) = RNPV \cdot VO(t),$$

where

$RN_3(t)$ = FTE *RN*s in hospital outpatient and emergency units in year t;

$RNPV$ = average number of FTE *RN*s per outpatient visit;[22] and

$VO(t)$ = number of outpatient visits in year t.

Nursing Home Submodel

This submodel estimates the number of nurses employed in nursing homes of all types, given an estimate of the number of resident-days of care required each year. Its structure, which is relatively uncomplicated, is dictated by a relative paucity of reliable data in this setting. This submodel has the form:

[18] This number is calculated by solving three simultaneous linear equations for each year t. The first of these equations is based on the assumption that a hospital budget is fixed and that the total inpatient budget for nursing staff is identical for *PN* and non-*PN* units. The second and third establish *RN*/aide and *LPN*/aide ratios, respectively, both of which represent the average ratios for *PN* units reported in the literature [Manthey, 1973; Manthey and Kramer, 1970; Logadon, 1973; Felton, 1972].

[19] The number of nurses with master's degrees is the driving force of this equation, since it is assumed the number of *CNS*s will be supply-limited in the near future. Estimates of the future number of nurses with master's degrees were derived from extrapolations of historical data [American Nurses' Association, 1974] which show an approximate exponential increase with time. Projected number indicates a growth from 2,117 nurses with master's degrees in 1972 to 4,740 in 1985.

[20] Source: American Nurses' Association [1974].

[21] In the period 1968–1972 the number of outpatient visits increased by 46.5 percent and the number of *RN*s employed in this setting increased by 46.8 percent [American Hospital Association, various dates, and Bureau of Health Manpower Resources Development, various dates].

[22] The value of this parameter which is based on analyses of data in the above references is $1.452\ (10-4)$.

$$RN_4(t) = \sum_j RNHD_j HD_j(t),$$

where

$RN_4(t)$ = number of FTE *RN*s employed in nursing homes in year t;
$RNHD_j$ = FTE *RN*s per day of care in type j nursing homes; and
$HD_j(t)$ = number of nursing home care days in year t in type j homes.

At present, two types of homes are treated: nursing care homes and personal care with nursing homes as defined by NCHS. Personal care of domiciliary care homes employ only a small fraction of the nurses in nursing homes; so they are grouped in the second category. $RNHD_j$ has not exhibited any marked trend in recent years, and should remain stable in the near future on the presumptions that no major legislation is passed regulating the staffing of nursing homes, and that no other significant changes in the nursing home environment will occur. Values of $RNHD_j$ were obtained from analyses of data in National Center for Health Statistics [various dates and undated-b], and were determined to be 1.369 (10^{-4}) for nursing care homes and 6.967 (10^{-5}) for personal care with nursing homes.

The HMO Clinic Submodel

This submodel projects the number of nurses required in HMO ambulatory clinics, given the total annual number of visits to such clinics. Nurses required in this setting are estimated independently of nurses in other non-HMO ambulatory care settings, because the nursing intensity in this setting, e.g., the number of RNs per visit, is significantly different. However, the data are relatively sparse, and do not allow the determination of its variation over time. Hence, it is assumed to remain stable in the absence of any empirical evidence to the contrary. Consequently, this submodel is:

$$RN_5(t) = RNHV \cdot HV(t),$$

where

$RN_5(t)$ = number of FTE *RN*s employed in HMO clinics in year t;
$RNHV$ = weighted average number of FTE *RN*s per visit;[23] and
$HV(t)$ = number of HMO visits by enrollees in year t (provided by the demand for service module).

Community Health and Other Submodel

This submodel is actually a compendium of other submodels which are grouped together, because they are, with little exception, determined independently from the detailed analyses of the population and demand-for-services model sections. That is, these estimates are primarily based on least squares linear regression of employment data over time. Nurse employment settings included in this category are;

1. community health, $RN_6(t)$;
2. all non-short-term general hospitals, $RN_7(t)$;
3. private duty and other nurses, $RN_8(t)$; and
4. nurse educators, $RN_9(t)$.

The community health portion of this submodel projects the requirements for several types of community health nurses. It can be summarized as:

$$RN_6(t) = RNCV \cdot RNCV \cdot HCV(t) + (1 + \alpha_1 t)\, RNBE + (\alpha_2)^t\, RNOH + (1 + \alpha_3 t)\, RNCH + (\alpha_2)^t\, RNOH + (1+\alpha_3 t)\, RNCH,$$

where

$RN_6(t)$ = number of FTE *RN*s employed in community health in year t;
$RNCV$ = number of FTE *RN*s per home care visit;
$HCV_s(t)$ = number of home care visits in year t;
$RNBE$ = number of FTE *RN*s employed by boards of education in 1972;[24]
$RNOH$ = number of FTE *RN*s employed in occupational health in 1972,[24] and
$RNCH$ = number of FTE *RN*s employed in other community health activities;[24]
α_j = empirically derived constants which reflect historical time series changes *RN*s employed in setting j.

[23] Value for this parameter is estimated to be 9.92×10^{-5} from data provided in Gorby and Associates [1974].

[24] Source: *Survey of Public Health Nursing 1968–1972*, Bureau of Health Manpower, 1975.

It is assumed in this model the number of home health nurses is proportional to the number of home care visits determined by the demand-for-services section. Note, however, that other types of community health nurses do not depend on the results of the demand-for-services section. This is because these categories will not be significantly influenced by changes in health insurance, and are thus assumed to grow in accordance with past trends. The constants (α_j) in the above model are derived from historical data at the national level, in particular, American Nurses' Association [1974] and Bureau of Health Manpower [1975].

Nurses in "other" hospitals include those working in all Federal and non-Federal long-term care hospitals. Care in the majority of these settings is already provided largely by public agencies, and is assumed to be insignificantly affected by national health insurance. Data from previous years [BHRD, various years, and American Hospital Association, 1974] indicate that at the national level, nurse employment in the aggregate is adequately described by a uniform growth pattern. Consequently, a linear model was used of the form:

$$RN_7(t) = (1 + \sigma t)\, RN_7(O),$$

where

$RN_7(t)$ = number of FTE *RN*s employed in "other" hospitals in year t;
$RN_7(O)$ = number of FTE *RN*s employed in "other" hospitals in 1972; and
σ = constant determined from linear regression on national data.

"Private duty and other" nurses is a category including all those not previously discussed except nurse educators. Like all "miscellaneous" categories, requirements in this group are difficult to determine because of a lack of appropriate time series data. However, analysis of data reported in [American Nurses' Association, 1974] indicates that employment in this setting is declining roughly in accordance with the following model:

$$RN_8(t) = (\gamma)^t\, RN_8(O),$$

where

$RN_8(t)$ = number of FTE *RN*s employed in private duty and other settings in year t;
$RN_8(O)$ = number of FTE *RN*s employed in private duty and other settings in 1972; and
γ = empirical constant determined from least squares linear regression on national data.[25]

Private duty nurses, the demand for whom is known to be falling rapidly, are the main component of this classification. There is little data or rationale to indicate that the health system changes under investigation will substantially reverse this trend.

The final nursing category consists of nurse educators. The estimated requirement for nurse educators depends on the incremental increase in the annual requirement for both *RN*s and *LPN*s[26] and has the general structure:

$$RN_9(t) = \sum_j \frac{f_j(t+1)\, RNG(t+1)}{NER_j(t+1)} \cdot ARE_j + \frac{LPG(t+1)}{NEL(t+1)} \cdot ALE\,,$$

where

$RN_9(t)$ = number of FTE *RN*s required in nursing education in year t;
$f_j(t+1)$ = fraction of graduates of *RN* programs in type j training programs in year t;[27]
$RNG(t+1)$ = number of graduates of *RN* programs required in year $t+1$ to meet total *RN* requirements estimated in all other settings (this number takes into account the facts that *RN*s are leaving the labor force and all graduates will not work full time);
$NER_j(t+1)$ = number of graduates of *RN* programs per FTE *RN* educator in type j programs in year $t+1$;[28]
ARE_j = number of FTE *RN*s in education administration positions per FTE *RN* educators in type j programs;

[25] See American Nurses' Association [1974].

[26] *LPN* requirements are also made for each practice setting in a manner similar to that for *RN*s.

[27] Values of these fractions were determined from data provided in Bureau of Health Manpower [1976].

[28] Linear projections of these ratios from data in *Facts about Nursing—1968, 1969, 1970–71, 1972–73* estimate a 15-percent decrease for diploma programs, a 73-percent increase for associate degree programs and a 64-percent increase for baccalaureate programs over the 1972–1985 period.

$LPG(t+1)$ = number of graduates of *LPN* programs required in year $t+1$;
$NEL(t+1)$ = number of graduates of *LPN* programs per FTE *RN* educator in year $t+1$;[29] and
ALE = number of FTE *RN*s in education administration positions per FTE *RN* educators in *LPN* education programs.

Three types of *RN* training programs are projected: diploma, AD, and baccalaureate programs. *LPN* training programs are completely aggregated, however, because of a scarcity of appropriate data.

The number of graduates of *RN* programs is based on the remaining required nurses after the contribution of changes in activity rate, number of foreign graduates, reinstatements of previously licensed nurses, and death. The number of graduates of *LPN* programs are assumed proportional to the changes in requirements based on analyses of time series data [American Nurses' Association, 1974]. Finally, it should be noted that the requirements for nurse educators are based on requirements for graduates in the succeeding year.

[29] Estimated to increase 52-percent over projection period from extrapolation of least squares regression on data in *Facts about Nursing—1967, 1970-71, 1972-73* (see American Nurses' Association [1974] for complete reference).

Appendix B

RESULTS USING THE VRI NURSE REQUIREMENTS MODEL

The Computer Model

In order to calculate projected nurse requirements from the analytic model described in appendix A, a FORTRAN language version of the model was programmed for use on the University of Michigan's Amdahl 470V/6 computer system. This program was exercised with various data bases to determine the requirements for nurses under each of the scenarios defined in the main text of this report. Also, many additional model runs were made to test the sensitivity of the model to various assumptions we have made. The results of these runs, some of which were summarized in the body of the report, are presented in their entirety in this appendix. This appendix discusses the formats in which scenario inputs are defined and in which scenario results are obtained.

The content of the appendix is organized in the same order as the material presented in the main body of the report for ease of reference. That is, model results concerning national health insurance, HMO enrollment, and role reformulation are presented, in that order, below; and the combined efforts of national health insurance and role reformulation are discussed following that. The remainder of this first section provides a general description of the types of inputs and outputs employed in the model.

Computer Model Inputs

In order to obtain results from the computer model for a particular scenario, one must arrange a set of inputs and make a run of the program. Program inputs are of two kinds: those common to all scenarios which are used to avoid repetitive calculations and those which explicitly define scenario characteristics. Inputs of the first type arise from minor structural differences between the analytic and computer models. We need not discuss these differences in detail except to note that their only function is to avoid the recalculation of factors which do not change from scenario to scenario. Inputs of the second type comprise the parameters used to define the effects of the health system changes under investigation.

Inputs Common to Scenarios.—The most important single factor common to all scenarios is the output of the population submodel described in appendix A. The total U.S. population projections are not affected by the health system changes under consideration, and hence remain unchanged in all model runs. As described in appendix A, these projections are based on Bureau of Census estimates, and are the most reasonable that can be made.

Inputs Defining Scenarios.—Inputs defining scenarios consist of health insurance parameters, HMO enrollment parameters, and role reformulation parameters. All of these parameters were included in the discussion of the analytic model (appendix A); however, they are repeated below to facilitate better understanding of the flexibility of the model in each of the analysis areas.

There are four parameters which can be varied to estimate national health insurance impact. These are: NHI implementation year, NHI implementation period, fraction of each population cohort covered by NHI or other insurance, and type of NHI plan implemented. The implementation year is any year from 1972 through 1985 in which a plan is deemed to take effect. The implementation is assumed to occur on January 1 of the implementation year. The implementation period is an integral number of years over which a plan is assumed to be uniformly phased into existence. The population coverage factor specifies what fraction of each population cohort is covered by the plan. The type of plan specifies the appropriate set of health service utilization data to represent the *per capita* consumption of individuals under this plan. This service utilization characterization is

used in the following sections to differentiate NHI plans, since it is more descriptive than a simple designation by prototypical NHI plans.

Two parameters whose values influence the impact of HMO growth are enrollment and HMO service utilization. The former data consist of the actual number of persons enrolled in HMOs by year and age-sex cohort for an assumed HMO growth rate. The latter consist of the annual *per capita* utilization of health services by HMO enrollees as a function of their cohort. In this respect, the treatment of HMOs is much the same as a health insurance plan in that as individuals become enrolled in an HMO, their consumption of health services becomes identical to that of previously enrolled persons.

There are four critical role reformulation parameters which together determine the growth in future acceptance of the role reformulation concepts we have examined. For each of the concepts, growth is assumed to occur uniformly from the base year to the end of the projection period.[1] Thus, the only input information required to describe this growth is the projected value of the particular parameter at the end of the projection period, 1985. The first two parameters are the fraction of hospital inpatient units which employ primary nursing by 1985 and the fraction of such units which employ only RNs (as opposed to a mix of RNs, LPNs, and aides; see appendix A). The third parameter is the 1985 fraction of clinical nurse specialists (CNSs) who are performing functions which are new to nursing since 1972. The final parameter is the 1985 fraction of unmet demand for physician services in offices that are supplied by nurses in practitioner or extended roles.

Computer Model Outputs

Two types of nurse requirement estimates are shown for each scenario in this appendix.[2] The first is a summary of the estimated requirements for RNs in full-time equivalent nursing positions, and the second converts these estimates into requirements for total number of nurses. Full-time equivalent positions are equal to the number of full-time nurses employed, plus one-half the number of part-time nurses employed. As explained in appendix A, actual model projections are made in terms of full-time equivalents. The conversion of these estimates is based on the ratio of total employed to full-time equivalent positions typical of the base year (1972). These ratios are shown in table B-1.

National Health Insurance

To demonstrate the effect of NHI alone on requirements for nurses, three principal scenarios were defined. In each of these, HMO enrollment and role reformulation parameters were held constant, while health insurance parameters were varied. HMO parameters were selected such that no significant change in HMO populations occurred, and role reformulation parameters were selected such that no growth in acceptance of role reformulation concepts occurred. The impact of varying these parameters on nurse requirements is addressed below.

The results of this section are the projected requirements, by year and setting, for registered nurses measured in terms of full-time equivalent positions and total employment. Because the main area of impact of NHI is on the utilization of services, however, we have also included for each scenario the output of the demand-for-services section. This output consists of the aggregate, national demand for services, by year and setting.

Table B-1.—Ratios of total employed nurses to full-time equivalent positions in 1972, by model setting

Setting	Ratio of total employed nurses to full-time equivalent positions in 1972
Short-term hospital inpatient[1]	1.170
Short-term hospital outpatient[1]	1.167
Physician offices[2]	1.159
Nursing homes[3]	1.261
Community health[3]	1.066
HMO clinics[4]	1.159
Other hospitals[1]	1.052
Private duty and other[2]	1.177
Nursing educators[2]	1.079

[1]Other nonuniform growth trends could be examined, but we have no empirical basis on which to assume such trends.

[2]In addition, various intermediate results produced by the model have been included for special analyses in some of the scenarios. These are discussed in the appropriate subsections.

[1]Source: *Nursing Personnel in Hospitals*, 1972 Survey of Hospitals Registered with the American Hospital Association (see Bureau of Health Resources Development [various dates]).

[2]Source: American Nurses' Association [1974].

[3]Source: National Center for Health Statistics [undated-c].

[4]Assumed to be same as that for physician offices.

The Norm

The norm or standard case represents a situation in which the health system continues on its present course, without institution of any national health insurance program. For this scenario, the population retains its base year insurance characterization. The fraction of the population having some sort of insurance protection remains as it was in the base year.

The majority of the health service utilization data for the health services of interest (see appendix A) were derived from analyses of the Health Interview Survey data tapes for 1972 related data. Using these tapes the *per capita* demands were computed for all the population characteristics of interest for hospital inpatient, outpatient, and physician office settings. The hospital inpatient and outpatient data were then normalized to agree with totals reported in American Hospital Association [various dates]. Nursing home utilization rates were estimated for the base year from data found in National Center for Health Statistics [1973a and undated-c], while *per capita* demands for home care visits were estimated from other sources [Bureau of Health Manpower, 1975; and Hurtado, Greenlick, and Lauvard, 1972].

To provide a mechanism for treating anticipated growth in health service utilization rates, the *per capita* demands for both the HMO and non-HMO populations were inflated at rates shown in table B-2. The growth rates adopted in this table are moderately conservative, since they exclude data which appear to reflect large step increases in insurance coverage (e.g., the increase in demand which accompanied the implementation of Medicare and Medicaid).[3]

The model estimates of service demands and nurse requirements for each year of the projection period are shown in table B-3. Figures in this table provide a best estimate of future RN requirements in the absence of the health system changes under investigation.

Table B-2.—Percent of change in per capita utilization of health services over projection period

Setting	Percent change 1972–1985
Hospital inpatient	[1]6.5
Hospital outpatient	[2]65.0
Physician office	[3]9.8
Nursing care homes	[4]117.0
Personal care homes	[4]–78.0
Home health care	0.0
HMO clinic	[5]9.8

[1]Based on average annual growth from 1970 to 1974, estimated from data in American Hospital Association [various dates].

[2]Based on average annual growth from 1962–1973, estimated from data in American Hospital Association [various dates].

[3]Based on analyses of physician visit data for 1970–1974 from National Center for Health Statistics [1973b].

[4]Based on average annual growth from 1969–1973, estimated from data in National Center for Health Statistics [1973a], and Bureau of Health Manpower [1975].

[5]Assumed to be equal to physician office growth rate.

NHI 1

The second NHI scenario, referenced hereafter as NHI 1, is designed to model the situation in which the portion of the population having neither private nor public insurance of any kind becomes insured. It is assumed for this scenario that as uncovered individuals become covered, they consume health services at the same rate as those in their respective cohorts who previously had health insurance. This is intended to reflect those NHI bills which do not necessarily provide benefits much greater than those already possessed by insured persons, but which guarantee some protection to everyone and thus plug the gaps in current public and private insurance coverage. This is typical of the AMA or Hospitals' plan (as discussed in chapter 3), and is in contrast to the Labor plan providing totally free care (as discussed below). This scenario assumes that if the benefits provided by NHI are not as extensive as those afforded to the currently insured, then they will supplement their NHI coverage through the purchase of additional private insurance. Furthermore, it is assumed that any cost advantages incurred as a consequence of NHI will not influence the currently insured to improve the total level of benefit of their insurance package.

Even if such legislation were passed this year, an unlikely event at best, the soonest it would be likely to be fully effective would be 1979. Consequently, it is assumed NHI will not be implemented until 1979. Also, even though not all proposed NHI programs have a schedule for

[3]It is assumed that significant improvements in the insurance coverage of the population (e.g., medicare/medicaid plus an increase in private insurance coverage) would influence *per capita* demands for health care. Unfortunately, there is insufficient data to relate these factors in any way other than to eliminate those years which demonstrate a significant increase in demand that appears to be the result of large-scale increases in insurance coverage.

APPENDIX B

Table B-3.—Detailed results, norm scenario

PROJECTED SERVICE DEMANDS (000's)

Year	Patient days	Outpatient visits	Office visits	Type 1 NH days	Type 2 NH days	Home visits	HMO clinic visits
1972	242,319.	164,060.	838,566.	329,848.	66,648.	32,424.	17,555.
1973	246,307.	173,019.	849,343.	367,126.	63,961.	32,941.	20,799.
1974	250,417.	182,058.	860,138.	406,117.	61,174.	33,483.	24,096.
1975	254,588.	191,178.	871,196.	447,151.	58,302.	34,049.	27,250.
1976	258,637.	200,403.	882,504.	488,080.	55,069.	34,535.	30,359.
1977	262,770.	209,857.	894,583.	529,853.	51,635.	34,996.	33,269.
1978	267,068.	219,563.	907,419.	573,121.	48,070.	35,473.	36,065.
1979	271,355.	229,424.	920,690.	617,086.	44,307.	35,925.	38,900.
1980	275,699.	239,428.	934,271.	661,460.	40,406.	36,388.	41,954.
1981	279,987.	249,577.	948,002.	707,657.	36,278.	36,816.	45,237.
1982	284,286.	259,721.	961,671.	753,508.	31,995.	37,228.	48,770.
1983	288,403.	269,864.	975,251.	800,818.	27,592.	37,668.	52,570.
1984	292,646.	280,025.	988,771.	851,011.	23,099.	38,149.	56,661.
1985	296,974.	290,138.	1,002,132.	905,041.	18,497.	38,703.	61,069.

PROJECTED REQUIREMENTS FOR FULL-TIME EQUIVALENT REGISTERED NURSES

Year	Short-term inpatient	Hospital outpatient	Physician office	Nursing homes	Community health	HMO clinic	Other hospitals	Private duty + misc	Educators	Total
1972	385,300	23,800	42,000	50,200	73,900	1,700	56,500	37,700	21,500	692,700
1973	397,500	25,100	42,200	55,100	75,800	2,100	58,500	35,900	21,300	713,300
1974	409,900	26,400	42,300	60,300	77,600	2,400	60,500	34,100	20,900	734,600
1975	422,700	27,800	42,500	65,800	79,500	2,700	62,600	32,400	20,700	756,600
1976	435,500	29,100	42,800	71,200	81,300	3,000	64,600	30,700	20,500	778,700
1977	448,700	30,500	43,100	76,700	83,100	3,300	66,600	29,200	20,400	801,600
1978	462,200	31,900	43,400	82,400	85,000	3,600	68,700	27,700	20,200	825,100
1979	476,500	33,300	43,800	88,200	86,800	3,900	70,700	26,400	20,100	849,100
1980	490,000	34,800	44,200	94,200	88,600	4,200	72,700	25,000	19,800	873,600
1981	504,200	36,200	44,700	100,200	90,400	4,500	74,700	23,800	19,500	898,300
1982	518,500	37,700	45,100	106,200	92,200	4,800	76,800	22,600	19,400	923,400
1983	532,900	39,200	45,600	112,400	94,100	5,200	78,800	21,500	19,500	949,100
1984	547,700	40,700	46,000	119,000	95,900	5,600	80,800	20,400	19,700	975,800
1985	562,700	42,100	46,500	126,200	97,800	6,100	82,900	19,400	19,500	1,003,100

PROJECTED REQUIREMENTS FOR TOTAL EMPLOYED REGISTERED NURSES

Year	Short-term inpatient	Hospital outpatient	Physician office	Nursing homes	Community health	HMO clinic	Other hospitals	Private duty + misc	Educators	Total
1972	450,800	27,800	48,700	63,300	78,800	2,000	59,400	44,100	23,200	798,100
1973	465,100	29,300	48,900	69,500	80,800	2,400	61,500	42,000	23,000	822,500
1974	479,600	30,800	49,000	76,000	82,700	2,800	63,600	39,900	22,600	847,000
1975	494,600	32,400	49,300	83,000	84,700	3,100	65,900	37,900	22,300	873,200
1976	509,500	34,000	49,600	89,800	86,700	3,500	68,000	35,900	22,100	899,100
1977	525,000	35,600	50,000	96,700	88,600	3,800	70,100	34,200	22,000	926,000
1978	540,800	37,200	50,300	103,900	90,600	4,200	72,300	32,400	21,800	953,500
1979	556,900	38,900	50,800	111,200	92,500	4,500	74,400	30,900	21,700	981,800
1980	573,300	40,600	51,200	118,800	94,400	4,900	76,500	29,200	21,400	1,010,300
1981	589,900	42,200	51,800	126,400	96,400	5,200	78,600	27,800	21,000	1,039,300
1982	606,600	44,000	52,300	133,900	98,300	5,600	80,800	26,400	20,900	1,068,800
1983	623,500	45,700	52,900	141,700	100,300	6,000	82,900	25,200	21,000	1,099,200
1984	640,800	47,500	53,300	150,100	102,200	6,500	85,000	23,900	21,300	1,130,600
1985	658,400	49,100	53,900	159,100	104,300	7,100	87,200	22,700	21,000	1,162,800

phasing-in benefits, there will still be a transient period, caused by delays in consumer awareness and other factors, over which demands for services will probably increase. Thus, as a conservative measure from the standpoint of impact on nurse requirements, analysis in this scenario assumed an implementation period of 2 years.

Data on the type and extent of insurance coverage in the population as a function of age/sex/income characteristics are nonexistent. Consequently, to estimate the population coverage fractions for input to the computer model, several assumptions were made. First, it was assumed coverage fractions were required only for hospital

and physician office services.[4] Second, it is assumed the population 65 years of age and older are fully insured, i.e., the elderly are covered by Medicare, which insures everyone eligible for social security or railroad retirement benefits.[5]

The under-65 population, then, may be found in one of three insurance states: privately insured, publicly insured, or uninsured. Public insurance in this group is primarily Medicaid, which covers low income families and certain other categories such as the blind and disabled.[6] As a result, any overlap in coverage between private and public insurance in this group is assumed to be negligible.

The coverage distribution of private hospital insurance for 1972, the base year in this study, was obtained from the Health Interview Survey for that year, and is shown in table B-4. The age and income categories shown are those adopted for use in our model. The distribution by sex is not shown, because it is approximately the same for both sexes. When applied to model estimates of the U.S. population for the same year, this data indicate that about 82 percent of the population is privately insured for hospital inpatient services.[7]

The 18 percent of the population not privately insured is either publicly insured or uninsured. If the former, they were assumed to be covered for both inpatient and ambulatory care. The number of Medicaid recipients[8] was 23.5 million persons in fiscal year 1973,[9] of which about 4 million were known to be age 65 or older [U.S. Government, 1975]. Thus, about 52 percent of the under-65 and nonprivately insured were eligible for public insurance. However, many of the remainder may indeed be eligible for Medicaid or may be insured under such other public programs as CHAMPUS or VA assistance. Consequently, the true fraction of the under-65, nonprivately insured population having some form of public insurance is between 50 percent and 100 percent. Assuming 75 percent as a moderate estimate,[10] we see that a little over 9 million persons, or only about 4.5 percent of the overall population, neither has nor is eligible for hospital insurance. The demographic distribution of the publicly insured and uninsured population was estimated by applying the 75 percent factor to the population remaining in each cohort after the known, privately insured group was deducted.

Using the above estimates of insurance coverage and estimates of the *per capita* demands for the insured and uninsured population,[11] the model estimates projected serviced demands and nurse requirements shown in table B-5. That is, given the fraction of insured and uninsured persons in each demographic group, the model simply assigns the insured *per capita* demands to the uninsured population.

Table B-4.—Fraction of population with private hospital insurance in 1972[1]

Age group	Family income (000's of $)					
	3	3–5	5–7	7–10	10–15	15+
<17	.213	.356	.586	.791	.884	.918
17–24	.491	.483	.631	.774	.833	.845
25–44	.290	.453	.678	.842	.912	.935
45–64	.383	.622	.772	.858	.924	.935

[1]Unpublished NCHS data from the 1972 Health Interview Survey [National Center for Health Statistics, undated-a].

NHI 2

The second form of national health insurance, referred to as NHI 2, is designed to represent the extreme situation with NHI in which an essentially free and universal plan is adopted. This scenario reflects the result of NHI plans such as that supported by organized labor (i.e., Kennedy-Corman bill as submitted to the 94th Congress). As in the previous scenario, it is assumed the plan will be implemented in 1979 and will require 2 years for its impact to reach full effect (i.e., the model implementation period). In this scenario, the currently insured and their effective coinsurance rate were combined with the uninsured to obtain an

[4]This is based on the concept that nursing home, HMO clinic, and home health services will not be sufficiently affected by the type of NHI being considered to significantly affect the Nation's requirement for nurses.

[5]The number of these individuals not covered in this way is on the order of a few hundred thousand [Davis, 1975]. Moreover, many of those not eligible for federally provided Medicare benefits may have purchased them, which they are entitled to do, and some of them may be eligible for Medicaid. (Four million of the elderly received Medicaid benefits in fiscal 1973 [U.S. Government, 1975]).

[6]Although financed by the Federal Government, Medicaid is administered by the States. Hence, precise eligibility requirements vary from State to State.

[7]The distribution of private ambulatory insurance was derived from this inpatient coverage by noting the proportion of persons with both ambulatory and inpatient coverage [Health Insurance Institute, 1975].

[8]Unfortunately, no data exist which describe the Medicaid eligible population.

[9]Calendar year 1972 data are not available, but the evidence [Davis, 1975] indicates the figures are only slightly less. Thus, fiscal 1973 data should not introduce significant error if used directly.

[10]This translates into about 14 percent (i.e., .75 × 18 percent) of the under-65 population have some form of public insurance.

[11]Demands for the insured and uninsured populations were derived from 1972 Health Interview Survey data tapes.

Table B-5.—Detailed results, NHI 1 scenario

PROJECTED SERVICE DEMANDS ('000's)

Year	Patient days	Outpatient visits	Office visits	Type 1 NH days	Type 2 NH days	Home visits	HMO clinic visits
1972	242,317.	164,058.	836,563.	329,848.	66,648.	32,424.	17,555.
1973	246,305.	173,016.	849,341.	367,126.	63,961.	32,941.	20,799.
1974	250,415.	182,055.	860,136.	406,117.	61,174.	33,483.	24,096.
1975	254,585.	191,176.	871,194.	447,151.	58,302.	34,049.	27,250.
1976	258,634.	200,401.	882,501.	488,080.	55,069.	34,535.	30,359.
1977	262,767.	209,854.	894,580.	529,853.	51,635.	34,996.	33,269.
1978	267,064.	219,561.	907,417.	573,121.	48,070.	35,473.	36,065.
1979	270,898.	287,094.	1,029,711.	617,086.	44,307.	35,925.	38,900.
1980	274,792.	359,733.	1,155,481.	662,460.	40,406.	36,388.	41,964.
1981	279,086.	374,965.	1,172,512.	707,657.	36,278.	36,816.	45,237.
1982	283,320.	390,237.	1,189,545.	753,508.	31,995.	37,228.	48,770.
1983	287,542.	405,529.	1,206,409.	800,818.	27,592.	37,668.	52,570.
1984	291,813.	420,822.	1,223,089.	851,011.	23,099.	38,149.	56,661.
1985	296,171.	435,978.	1,239,374.	905,041.	18,497.	38,703.	61,069.

PROJECTED REQUIREMENTS FOR FULL-TIME EQUIVALENT REGISTERED NURSES

Year	Short-term inpatient	Hospital outpatient	Physician office	Nursing homes	Community health	HMO clinic	Other hospitals	Private duty + misc	Educators	Total
1972	385,300	23,800	42,000	50,200	73,900	1,700	56,500	37,700	21,500	692,700
1973	397,400	25,100	42,200	55,100	75,800	2,100	58,500	35,900	21,300	713,300
1974	409,900	26,400	42,300	60,300	77,600	2,400	60,500	34,100	20,900	734,600
1975	422,700	27,800	42,500	65,800	79,500	2,700	62,600	32,400	20,700	756,600
1976	435,500	29,100	42,800	71,200	81,300	3,000	64,600	30,700	20,500	778,700
1977	448,700	30,500	43,100	76,700	83,100	3,300	66,600	29,200	20,400	801,600
1978	462,200	31,900	43,400	82,400	85,000	3,600	68,700	27,700	32,200	837,000
1979	475,300	41,700	56,900	88,200	86,800	3,900	70,700	26,400	33,700	883,500
1980	488,600	52,200	72,900	94,200	88,600	4,200	72,700	25,000	21,000	919,500
1981	502,800	54,400	73,900	100,200	90,400	4,500	74,700	23,800	20,700	945,400
1982	517,100	56,700	74,800	106,200	92,200	4,800	76,800	22,600	20,600	971,700
1983	531,500	58,900	75,700	112,400	94,100	5,200	78,800	21,500	20,600	998,700
1984	546,300	61,100	76,600	119,000	95,900	5,600	80,800	20,400	20,800	1,026,500
1985	561,400	63,300	77,400	126,200	97,800	6,100	82,900	19,400	20,700	1,055,100

PROJECTED REQUIREMENTS FOR TOTAL EMPLOYED REGISTERED NURSES

Year	Short-term inpatient	Hospital outpatient	Physician office	Nursing homes	Community health	HMO clinic	Other hospitals	Private duty + misc	Educators	Total
1972	450,800	27,800	48,700	63,300	78,800	2,000	59,400	44,100	23,200	798,100
1973	465,000	29,300	48,900	69,500	80,800	2,400	61,500	42,000	23,000	822,400
1974	479,600	30,800	49,000	76,000	82,700	2,800	63,600	39,900	22,600	847,000
1975	494,600	32,400	49,300	83,000	84,700	3,100	65,900	37,900	22,300	873,200
1976	509,500	34,000	49,600	89,800	86,700	3,500	68,000	35,900	22,100	899,100
1977	525,000	35,600	50,000	96,700	88,600	3,800	70,100	34,200	22,000	926,000
1978	540,800	37,200	50,300	103,900	90,600	4,200	72,300	32,400	34,700	966,400
1979	556,100	48,700	65,900	111,200	92,500	4,500	74,400	30,900	36,400	1,020,600
1980	571,700	60,900	84,500	118,800	94,400	4,900	76,500	29,200	22,700	1,063,600
1981	588,300	63,500	85,700	126,400	96,400	5,200	78,600	27,800	22,300	1,094,200
1982	605,000	66,200	86,700	133,900	98,300	5,600	80,800	26,400	22,200	1,125,100
1983	621,900	68,700	87,700	141,700	100,300	6,000	82,900	25,200	22,200	1,156,600
1984	639,200	71,300	88,800	150,100	102,200	6,500	85,000	23,900	22,400	1,189,400
1985	656,800	73,900	89,700	159,100	104,300	7,100	87,200	22,700	22,300	1,223,100

average effective coinsurance rate on a cohort-by-cohort basis.

The derivation of health service utilization rates under this scenario was somewhat more complex. To estimate the *per capita* demands for hospital inpatient, hospital outpatient, and physician office services, an estimate was made of the change in price of these services resulting from passage of NHI. Then, the impact of this price change was computed using the published results of social experiments on small populations. For all other settings, the *per capita* demands estimated for the norm (i.e., scenario 1) were used.

The measure of price used for health services

was the effective coinsurance rate, or average fraction of expenses paid out-of-pocket by the consumer. Under the free plan, this coinsurance rate is, of course, zero. The coinsurance rates existing in the base year are determined as follows. For hospital inpatient services, the fraction of expense paid out-of-pocket in the base year has been estimated at roughly 10 percent [Worthington, 1975]. Outpatient physician services coinsurance rates were determined as follows:

$$C_o = \frac{C - F C_i}{1 - F},$$

where

C = average coinsurance rate for all physician services;

C_o = coinsurance rate for outpatient physician services;

C_i = coinsurance rate for inpatient physician services; and

F = fraction of all physician services that are inpatient physician services.

Assuming that C_i is approximately the same as the coinsurance rate for all inpatient services (or ≈ .1) and noting that F was about one-third in the base year [Newhouse, Phelps, and Schwartz, 1974], the value for C_o over the entire population is about 60 percent.

The results of several small-scale, social experiments designed to estimate the elasticity of demand for health services as a function of price were applied to compute the effect of these coinsurance rates on the demand for services. Estimates of the demand for hospital inpatient services, as a function of price, rely on research by Haney and Riedal [1970], which Phelps and Newhouse [1973] have interpreted to imply about an 8-percent increase in patient days for NHI of the type we are considering. Estimates for ambulatory services (hospital outpatient and physician office settings) are based on data from Scitovsky and Snyder [1972] measuring the response to changes in physician service prices of a group of insurance subscribers in Palo Alto, California. Applying the experimental data to the *per capita* demands estimated for the base year, table B-6 displays the projected *per capita* demands encountered under NHI 2. The table also shows model estimates of the requirements for nurses to satisfy the service demands projected under the NHI 2 scenario.

Related Analyses

The above NHI scenarios assume the average price change with enactment of national health insurance is independent of when it is implemented. This need not and probably will not be the case, since the degree of health insurance coverage experienced by the population is increasing annually (see, for example, Health Insurance Institute [1975]). The matter is particularly critical in the ambulatory setting both because major changes will occur with NHI and because significant private insurance changes in this area are taking place [Mueller, 1975].

To investigate the degree to which this change in insurance coverage can influence our estimate of NHI impact, data from Worthington [1975] was analyzed to estimate the change in effective coinsurance rate with time. The estimated values for the ambulatory coinsurance rate (C_o) are given below.

Year	C_o
1968	.67
1969	.63
1970	.62
1971	.60
1972	.59
1973	.55
1974	.53

The relationship between the value of C_o and time is very closely approximated by the function,

$$C_o = .69 - .02t$$

where t is measured in years from 1972.

Extrapolating this function to 1979 yields a 45-percent coinsurance rate and to 1985 yields a 33-percent coinsurance rate. Table B-7 contains detailed results for a model run which is identical to table B-6 in all respects except that the coinsurance rate for hospital outpatient and physician office services is assumed to decline from 60 percent to 45 percent by 1979. Then, beginning in

APPENDIX B

Table B-6.—Detailed results, NHI 2 scenario

PROJECTED SERVICE DEMANDS (000's)

Year	Patient days	Outpatient visits	Office visits	Type 1 NH days	Type 2 NH days	Home visits	HMO clinic visits
1972	242,319.	164,060.	838,586.	329,848.	66,648.	32,424.	17,555.
1973	246,307.	173,019.	849,343.	367,126.	63,961.	32,941.	20,799.
1974	250,417.	182,058.	860,138.	406,117.	61,174.	33,483.	24,096.
1975	254,568.	191,178.	871,196.	447,151.	58,302.	34,049.	27,250.
1976	258,637.	200,403.	882,504.	488,080.	55,069.	34,535.	30,359.
1977	262,770.	209,757.	894,563.	529,853.	51,635.	34,996.	33,269.
1978	267,066.	219,563.	907,419.	573,121.	48,070.	35,473.	36,065.
1979	281,574.	322,560.	1,293,334.	617,085.	44,307.	35,923.	38,900.
1980	296,578.	433,421.	1,689,280.	662,460.	40,406.	36,388.	41,954.
1981	300,908.	451,341.	1,712,672.	707,657.	36,278.	36,816.	45,237.
1982	305,367.	469,094.	1,735,487.	753,508.	31,995.	37,228.	48,770.
1983	309,802.	486,748.	1,757,891.	800,818.	27,502.	37,668.	52,570.
1984	314,283.	504,385.	1,780,029.	851,011.	23,099.	38,149.	56,661.
1985	318,842.	521,846.	1,801,778.	905,041.	18,497.	38,703.	61,069.

PROJECTED REQUIREMENTS FOR FULL-TIME EQUIVALENT REGISTERED NURSES

Year	Short-term inpatient	Hospital outpatient	Physician office	Nursing homes	Community health	HMO clinic	Other hospitals	Private duty + misc	Educators	Total
1972	385,300	23,800	42,000	50,200	73,900	1,700	56,500	37,700	21,500	692,700
1973	397,500	25,100	42,200	55,100	75,800	2,100	58,500	35,900	21,300	713,300
1974	409,900	26,400	42,300	60,300	77,600	2,400	60,500	34,100	20,900	734,600
1975	422,700	27,800	42,500	65,800	79,500	2,700	62,600	32,400	20,700	756,600
1976	435,500	29,100	42,800	71,200	81,300	3,000	64,600	30,700	20,500	778,700
1977	448,700	30,500	43,100	76,700	83,100	3,300	66,600	29,200	20,400	801,600
1978	462,200	31,900	43,400	82,400	85,000	3,600	68,700	27,700	64,900	869,800
1979	491,700	46,800	91,400	88,200	86,800	3,900	70,700	26,400	64,300	970,100
1980	522,300	62,900	138,500	94,200	88,600	4,200	72,700	25,000	23,300	1,031,800
1981	537,400	65,500	139,800	100,200	90,400	4,500	74,700	23,800	23,000	1,059,300
1982	552,500	68,100	141,200	106,200	92,200	4,800	76,800	22,600	22,800	1,087,300
1983	567,800	70,700	142,800	112,400	94,100	5,200	78,800	21,500	22,900	1,116,000
1984	583,500	73,200	144,100	119,000	95,900	5,600	80,800	20,400	23,000	1,145,600
1985	599,400	75,800	145,500	126,200	97,800	6,100	82,900	19,400	23,200	1,176,100

PROJECTED REQUIREMENTS FOR TOTAL EMPLOYED REGISTERED NURSES

Year	Short-term inpatient	Hospital outpatient	Physician office	Nursing homes	Community health	HMO clinic	Other hospitals	Private duty + misc	Educators	Total
1972	450,800	27,800	48,700	63,300	78,800	2,000	59,400	44,100	23,200	798,100
1973	465,100	29,300	48,900	69,500	80,800	2,400	61,500	42,000	23,000	822,500
1974	479,600	30,800	49,000	76,000	82,700	2,800	63,600	39,900	22,600	847,000
1975	494,600	32,400	49,300	83,000	84,700	3,100	65,900	37,900	22,300	873,200
1976	509,500	34,000	49,600	89,800	86,700	3,500	68,000	35,900	22,100	899,100
1977	525,000	35,600	50,000	96,700	88,600	3,800	70,100	34,200	22,000	926,000
1978	540,800	37,200	50,300	103,900	90,600	4,200	72,300	32,400	70,000	1,001,700
1979	575,300	54,600	106,900	111,200	92,500	4,500	74,400	30,900	69,400	1,118,700
1980	611,100	73,400	160,500	118,800	94,400	4,900	76,500	29,200	25,100	1,193,900
1981	628,800	76,400	162,000	126,400	96,400	5,200	78,600	27,800	24,800	1,226,400
1982	646,400	79,500	163,700	133,900	98,300	5,600	80,800	26,400	24,600	1,259,200
1983	664,300	82,500	165,300	141,700	100,300	6,000	82,900	25,200	24,700	1,292,900
1984	682,700	85,400	167,000	150,100	102,200	6,500	85,000	23,900	24,800	1,327,600
1985	701,300	88,500	168,600	159,100	104,300	7,100	87,200	22,700	25,000	1,363,800

1979, it declines from 45 percent to zero in 2 years as a result of passage of NHI 2.

From the results of table B-7, it is apparent that the chief difference between this scenario and that of NHI 2 is a matter of timing. That is, the nurse requirements are essentially the same in 1985 whether the price is decreased from 60 percent to 45 percent by private insurance and then to zero by NHI or whether it simply goes directly from 60 percent to zero in the implementation year.

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Table B-7.—Detailed results, alternate NHI 2 scenario

PROJECTED SERVICE DEMANDS (000's)

Year	Patient days	Outpatient visits	Office visits	Type 1 NH days	Type 2 NH days	Home visits	HMO clinic visits
1972	242,319.	164,060.	838,566.	329,848.	66,648.	32,424.	17,555.
1973	246,304.	178,911.	878,129.	367,124.	63,961.	32,941.	20,799.
1974	250,414.	194,456.	918,434.	406,116.	61,173.	33,483.	24,096.
1975	254,585.	210,694.	959,742.	447,149.	58,302.	34,048.	27,250.
1976	258,635.	227,653.	1,002,014.	488,079.	55,069.	34,535.	30,359.
1977	262,769.	245,475.	1,045,857.	529,852.	51,635.	34,996.	33,269.
1978	267,066.	264,215.	1,091,345.	573,121.	48,070.	35,473.	36,065.
1979	281,574.	345,645.	1,386,502.	617,085.	44,307.	35,925.	38,900.
1980	296,378.	433,421.	1,689,280.	662,460.	40,406.	36,388.	41,954.
1981	300,908.	451,341.	1,712,672.	707,657.	36,278.	36,816.	45,237.
1982	305,367.	469,094.	1,735,487.	753,508.	31,995.	37,228.	48,770.
1983	309,802.	486,748.	1,757,891.	800,818.	27,592.	37,668.	52,570.
1984	314,283.	504,365.	1,780,029.	851,011.	23,099.	38,149.	56,661.
1985	318,842.	521,846.	1,801,778.	905,041.	18,497.	38,703.	51,069.

PROJECTED REQUIREMENTS FOR FULL-TIME EQUIVALENT REGISTERED NURSES

Year	Short-term inpatient	Hospital outpatient	Physician office	Nursing homes	Community health	HMO clinic	Other hospitals	Private duty + misc	Educators	Total
1972	385,300	23,800	42,000	50,200	73,900	1,700	56,500	37,700	24,600	695,800
1973	397,400	26,000	45,600	55,100	75,800	2,100	58,500	35,900	24,400	720,700
1974	409,900	28,200	49,300	60,300	77,600	2,400	60,500	34,100	24,300	746,600
1975	422,700	30,600	53,200	65,800	79,500	2,700	62,600	32,400	24,500	773,900
1976	435,500	33,100	57,800	71,200	81,300	3,000	64,600	30,700	24,800	802,100
1977	448,700	35,600	63,400	76,700	83,100	3,300	66,600	29,200	23,800	830,500
1978	462,200	38,400	67,600	82,400	85,000	3,600	68,700	27,700	55,800	891,400
1979	491,700	50,200	102,700	88,200	86,800	3,900	70,700	26,400	56,400	977,000
1980	522,300	62,900	138,500	94,200	88,600	4,200	72,700	25,000	23,300	1,031,800
1981	537,400	65,500	139,800	100,200	90,400	4,500	74,700	23,800	23,000	1,059,300
1982	552,500	68,100	141,200	106,200	92,200	4,800	76,800	22,600	22,800	1,087,300
1983	567,800	70,700	142,600	112,400	94,100	5,200	78,800	21,500	22,900	1,116,000
1984	583,500	73,200	144,100	119,000	95,900	5,600	80,800	20,400	23,000	1,145,600
1985	599,400	75,800	145,500	126,200	97,800	6,100	82,900	19,400	22,900	1,175,800

PROJECTED REQUIREMENTS FOR TOTAL EMPLOYED REGISTERED NURSES

Year	Short-term inpatient	Hospital outpatient	Physician office	Nursing homes	Community health	HMO clinic	Other hospitals	Private duty + misc	Educators	Total
1972	450,800	27,800	48,700	63,300	78,800	2,000	59,400	44,100	26,500	801,400
1973	465,000	30,300	52,900	69,500	80,800	2,400	61,500	42,000	26,300	830,700
1974	479,600	32,900	57,100	76,000	82,700	2,800	63,600	39,900	26,200	860,800
1975	494,600	35,700	61,700	83,000	84,700	3,100	65,900	37,900	26,400	893,000
1976	509,500	38,600	67,000	89,800	86,700	3,500	68,000	35,900	26,800	925,800
1977	525,000	41,500	73,500	96,700	88,600	3,800	70,100	34,200	25,700	959,100
1978	540,800	44,800	78,300	103,900	90,600	4,200	72,300	32,400	60,200	1,027,500
1979	575,300	58,600	119,000	111,200	92,500	4,500	74,400	30,900	60,900	1,127,300
1980	611,100	73,400	160,500	118,800	94,400	4,900	76,500	29,200	25,100	1,193,900
1981	628,800	76,400	162,000	126,400	96,400	5,200	78,600	27,800	24,800	1,226,400
1982	646,400	79,500	163,700	133,900	98,300	5,600	80,800	26,400	24,600	1,259,200
1983	664,300	82,500	165,300	141,700	100,300	6,000	82,900	25,200	24,700	1,292,900
1984	682,700	85,400	167,000	150,100	102,200	6,500	85,000	23,900	24,800	1,327,600
1985	701,300	88,500	168,600	159,100	104,300	7,100	87,200	22,700	24,700	1,363,500

Health Maintenance Organizations

As noted in appendix A, there are two factors influencing the impact of HMO expansion on nursing personnel requirements. The first factor, the difference between the *per capita* demands of HMO enrollees and non-HMO enrollees, helps to determine the degree to which the second factor, the number of HMO enrollees affects nurse manpower requirements. In this analysis the second factor is varied to reflect alternate HMO growth scenarios. This section first discusses the deriva-

tion of the *per capita* demands for HMO enrollees, then describes three HMO growth scenarios and the attendant estimates of requirements for nurses.

Utilization of Health Services in HMOs

In the absence of cohort-specific service demands for HMO enrollees, the model estimates these demands by assuming they are proportional to the nonenrollee demands of the same cohort. The proportionality constants used, k_i, depend only on the service setting, and were assumed to be independent of time.

The first constant, k_1, is the ratio of hospital inpatient utilization (measured in terms of patient days) of HMO enrollees to that of the total population and is defined as

$$k_1 = \frac{BD}{f_i BD_i},$$

where

BD = bed days *per capita* of the HMO;

f_i = fraction of HMO enrollees in age category i; and

BD_i = bed days *per capita* of the total population in age category i.

Then, by weighting the estimates of k_1 from each HMO by the enrollment of that HMO, k_1 is estimated to be 0.439 (as indicated in table B-8).

The second constant, k_2, is the ratio of outpatient utilization of HMO enrollees to that of the total population,[12] and is defined as

$$k_2 = \frac{V}{V_p} \cdot \frac{V_p}{V_p + V_o},$$

where

V = *per capita* outpatient visits by HMO enrollees;

V_p = *per capita* physician office of the total population; and

V_o = hospital outpatient visits of the total population.

[12]Recall that HMO enrollees utilize outpatient services in the HMO clinic setting rather than the hospital outpatient and physician office settings.

Table B-8.—HMO inpatient utilization, actual versus predicted

Plan name	Enrollment[1]	Bed days *per capita*[2]	Predicted bed days *per capita*[3]	Ratio[4]
Group Health Co-Op of Puget Sound	182,273	0.4337	1.110	0.391
Metro Health Plan	77,710	0.6605	1.043	0.633
HIP of New York	750,927	0.5260	1.227	0.429
Group Health Association	85,094	0.4240	0.991	0.428
Harvard HP	31,153	0.4197	0.942	0.446
St. Louis Labor HI	38,233	0.5610	1.078	0.520
Inland Health Association	2,552	0.7151	1.657	0.432
Community Health Center	3,650	0.6177	1.510	0.409
Columbia Medical Plan[5]	2,379	0.335	0.938	0.357
Rhode Island GHA	12,824	0.5029	1.061	0.474
Kaiser of Portland[6]	83,646	0.4980	1.174	0.424
GHA of Sault Ste. Marie[7]	5,400	0.979	1.284	0.760
Weighted average[8]	—	—	—	0.439

[1]Gorby and Associates [1974].

[2]*Ibid.*

[3]Calculated from the formula $PD = \Sigma f_i PD_i$, where PD denotes predicted bed days, f_i denotes fraction of HMO enrollees that are in age category i (for $i = 1$, 0 – 14; $i = 2$, 15 – 64; $i = 3$, >65. Source: *Ibid.*, exhibit 4), and PD_i denotes patient days *per capita* of the civilian population in age category i.

[4]Bed days *per capita*/predicted bed days *per capita*.

[5]See Peterson [1971].

[6]See Seward, Blank, and Greenlick [1968].

[7]See Hastings, *et al.* [1973].

[8]Weighted according to the number of enrollees in each HMO.

Table B-9.—HMO outpatient utilization, actual versus predicted

Plan name	Enrollment[1]	Visits per enrollee[2]	Physician office visits per capita[3]	Ratio[4]
Group Health Co-Op of Puget Sound	182,273	3.953	4.96	0.797
Metro Health Plan	77,710	2.135	4.90	0.436
HIP of New York	750,927	4.338[9]	5.02	0.864
Group Health Association	85,094	3.413	4.89	0.698
Harvard CHP	31,153	4.139	4.86	0.852
St. Louis Labor HI	38,233	4.995	4.74	1.054
Community Health Center	3,650	7.018	5.18	1.355
Yale Health Plan	19,178	4.678	4.96	0.943
Rhode Island GHA	12,824	3.090	4.81	0.642
Kaiser of Portland[5]	83,646	3.332	5.00	0.666
Columbia Medical Plan[6]	2,359	8.000	4.85	1.650
GHA of Sault Ste. Marie[7]	5,400	—	—	0.953
Weighted average[8]	—	—	—	0.811

[1]See Corby and Associates [1974].
[2]*Ibid.*
[3]Calculated from the formula $V = \Sigma B_i V_i$, where V denotes predicted office visits *per capita*, B denotes fraction of HMO enrollment in age category i and V_i denotes visits *per capita* of the civilian population in age category i, see NCHS, [1975a].
[4]Visits per enrollee predicted visits *per capita*.
[5]See Seward, Blank, and Greenlick, [1966].
[6]See Peterson, [1971].
[7]See Mott, Hastings, and Barclay, [1973].
[8]Weighted according to the number of enrollees in each HMO.
[9]Corrected to include visits to allied health professionals by multiplying physician visits *per capita* by 1/0.881. (Approximately 88.1 percent of office visits to HMOs are to physicians, see Greenlick, *et al.* [1972].)

Using the data in table B-9 to obtain an estimate of V/V_p and the data in table B-10 to correct this estimate for out-of-area services,[13] V/V_p is estimated to be 0.856 (i.e., 0.811 × 1.055). From NCHS [1973b] and AHA [1974], it can be derived that $V_p/V_p + V_p$ is about 0.84 so that $k_2 = 0.722$.

HMO enrollees are assumed to utilize nursing home services at this same rate as the general population, due to the lack of any reported data in this area. This assumption appears to be reasona-

[13]We assume that all out-of-area services are outpatient services; see table B-15.

Table B-10.—Correction for out-of-area services

Plan name	Enrollment	Distribution of plan costs[1]		
		Medical services	Out of area	Ratio
Group Health Co-Op of Puget Sound	182,273	0.619	0.040	0.065
Metro Health Plan	77,710	[2]0.578	0.065	0.112
Group Health Association	85,094	0.641	0.003	0.005
Harvard CHP	31,153	59,400	0	0
Group Health of St. Paul	56,266	50.200	0	0
St. Louis Labor Health Institute	38,233	49.700	0	0
Inland Health Association	2,552	31.500	0.045	0.143
Community Health Center	3,650	0.337	0.306	0.908
Northpoint	17,810	0.390	0.090	0.231
CHCCP	10,049	0.460	0	0
Yale Health Plan	19,178	0.587	0.002	0.003
Weighted average	—	—	—	0.055

[1]Corby and Associates [1974].
[2]Weighted average of other HMOs.

ble, since intermediate and long-term care is considered to be a supplemental health service [National Archives and Records Service, 1974]. Thus, most HMOs either provide this service on a fee-for-service basis or do not provide it at all.

Since the *per capita* utilization of home health services of the general, civilian population was itself estimated from data from the Kaiser of Portland HMO, the demand for these services is assumed to be identical between HMO and non-HMO enrollees.

Table B-11.—Actual net increase operational HMOs, by quarter[1]

Quarter ending	*Net increase*[2]
October 1, 1975	—
July 1, 1975	4
April 1, 1975	−4
January 1, 1975	1
October 1, 1974	18
July 1, 1974	13
April 1, 1974	19

[1]Wetherville and Nordby [1975].

[2]Actual net increase in operational HMOs is defined to be the number of newly operational HMOs minus the number of HMOs that have merged with other organizations or that have stopped providing prepaid care.

HMO Scenarios

In this analysis three scenarios for HMO enrollment are postulated—low, average, and high growth. The low growth scenario presumes that the abrupt drop in the rate of HMO formation experienced in 1975 (see table B-11) is not transient, but will continue into the future. In this scenario no new HMOs will become operational, and existing HMOs will experience a growth in HMO enrollment which corresponds to the historical rate. This results in an increase in enrollment from 2.4 percent of the population in 1972 to 6.7 percent in 1985.

The second or average growth scenario assumes the rate of increase in the number of HMOs per quarter will be identical to the average rate experienced between January 1974 and July 1975. In this scenario 34 new HMOs are formed annually, and 8.7 percent of the population are enrolled in HMOs by 1985.

In the third or high growth scenario, the analysis assumes that changes to the 1973 HMO Act resulting in a high rate of HMO growth will be made. Here it is assumed that the rate of increase in the number of HMOs is primarily constrained by the number of HMOs currently in the formational stage of development and that:

1. the number of formational HMOs remain constant at the 1975 average of 162,[14]
2. all formational HMOs eventually become operational, and
3. it requires 2.5 years for an HMO to pass through the formational stage [Wetherville and Nordby, 1975].

The resultant annual increase in the number of new HMOs then becomes approximately 65,[15] and HMO enrollment increases from 2.4 percent of the population in 1972 to 10.6 percent of the population in 1985.

In each of these scenarios, no impact from the other major health system changes is assumed to occur. That is, there will be no national health insurance and no growth in acceptance of role reformulation concepts. Since the low scenario assumed no new HMOs would formulate, and since this was also the case in the "norm" of the previous chapter, the results of the low HMO scenario are equivalent to the "norm" and are not reproduced here. The results for the moderate and high HMO scenarios are reported in tables B-12 and B-13 which follow.

Role Reformulation

To demonstrate the effects of role reformulation on requirements for nurses, several scenarios were defined. In each of these, health insurance and HMO growth parameters were maintained at constant levels to permit isolation of role reformulation effects. These parameters were selected to correspond with the norm NHI scenario and the low growth HMO enrollment scenario as defined previously in this appendix.

As discussed in appendix A and chapter 4 of this report, the most significant potential impacts from role reformulation arise from three concepts. These are the primary nursing (PN) concept, increased use of clinical nurse specialists (CNSs) in

[14]Average number of formational HMOs, based on FY 1975 data (see Wetherville and Nordby [1975] and other editions of the *Interstudy*, Census of HMOs).

[15]This is approximately the growth rate experienced during the first 3 quarters of 1974.

Table B-12.—Detailed results, moderate HMO growth scenario

PROJECTED SERVICE DEMANDS (000's)

Year	Patient days	Outpatient visits	Office visits	Type 1 NH days	Type 2 NH days	Home visits	HMO clinic visits
1972	242,319.	164,060.	838,566.	329,848.	66,648.	32,424.	17,555.
1973	246,307.	173,019.	849,343.	367,126.	63,961.	32,941.	20,799.
1974	250,417.	182,058.	860,138.	406,117.	61,174.	33,483.	24,096.
1975	254,523.	191,088.	870,792.	447,151.	58,302.	34,049.	27,596.
1976	258,439.	200,119.	881,263.	488,080.	55,069.	34,535.	31,423.
1977	262,364.	209,259.	892,055.	529,853.	51,835.	34,996.	35,436.
1978	266,397.	218,545.	903,248.	573,121.	48,070.	35,473.	39,643.
1979	270,385.	227,902.	914,638.	617,086.	44,307.	35,925.	44,092.
1980	274,401.	237,335.	926,178.	662,460.	40,406.	36,388.	48,895.
1981	278,336.	246,839.	937,697.	707,657.	36,278.	36,816.	54,074.
1982	282,172.	256,258.	948,960.	753,507.	31,995.	37,228.	59,659.
1983	285,956.	265,592.	959,956.	800,818.	27,592.	37,666.	65,680.
1984	289,753.	274,849.	970,668.	851,011.	23,099.	38,149.	72,172.
1985	293,597.	283,958.	980,992.	906,041.	18,497.	38,703.	79,177.

PROJECTED REQUIREMENTS FOR FULL-TIME EQUIVALENT REGISTERED NURSES

Year	Short-term inpatient	Hospital outpatient	Physician office	Nursing homes	Community health	HMO clinic	Other hospitals	Private duty + misc	Educators	Total
1972	385,300	23,800	42,000	50,200	73,900	1,700	56,500	37,700	21,500	692,700
1973	397,500	25,100	42,200	55,100	75,800	2,100	58,500	35,900	21,300	713,300
1974	409,900	26,400	42,300	60,300	77,600	2,400	60,500	34,100	20,900	734,500
1975	422,600	27,700	42,500	65,800	79,500	2,700	62,600	32,400	20,500	756,300
1976	435,200	29,100	42,600	71,200	81,300	3,100	64,600	30,700	20,200	778,100
1977	448,100	30,400	42,700	76,700	83,100	3,500	66,600	29,200	20,100	800,400
1978	461,200	31,700	42,900	82,400	85,000	3,900	68,700	27,700	19,800	823,300
1979	474,500	33,100	43,000	88,200	86,800	4,400	70,700	26,400	19,600	846,700
1980	488,000	34,500	43,200	94,200	88,600	4,900	72,700	25,000	19,300	870,400
1981	501,600	35,800	43,400	100,200	90,400	5,400	74,700	23,800	19,000	894,400
1982	515,200	37,200	43,600	106,200	92,200	5,900	76,800	22,600	18,900	918,600
1983	528,900	38,600	43,800	112,400	94,100	6,500	78,800	21,500	18,900	943,400
1984	542,900	39,900	43,900	119,000	95,900	7,200	80,800	20,400	19,100	969,100
1985	557,100	41,200	44,000	126,200	97,800	7,900	82,900	19,400	18,900	995,300

PROJECTED REQUIREMENTS FOR TOTAL EMPLOYED REGISTERED NURSES

Year	Short-term inpatient	Hospital outpatient	Physician office	Nursing homes	Community health	HMO clinic	Other hospitals	Private duty + misc	Educators	Total
1972	450,800	27,800	48,700	63,300	78,800	2,000	59,400	44,100	23,200	798,100
1973	465,100	29,300	48,900	69,500	80,800	2,400	61,500	42,000	23,000	822,500
1974	479,600	30,800	49,000	76,000	82,700	2,800	63,600	39,900	22,600	847,000
1975	494,400	32,300	49,300	83,000	84,700	3,100	65,900	37,900	22,100	872,700
1976	509,200	34,000	49,400	89,800	86,700	3,600	68,000	35,900	21,800	898,400
1977	524,300	35,500	49,500	96,700	88,600	4,100	70,100	34,200	21,700	924,700
1978	539,600	37,000	49,700	103,900	90,600	4,500	72,300	32,400	21,400	951,400
1979	555,200	38,600	49,800	111,200	92,500	5,100	74,400	30,900	21,100	978,800
1980	571,000	40,300	50,100	118,800	94,400	5,700	76,500	29,200	20,800	1,006,300
1981	586,900	41,800	50,300	126,400	96,400	6,300	78,600	27,800	20,500	1,035,000
1982	602,800	43,400	50,500	133,900	98,300	6,800	80,800	26,400	20,400	1,092,600
1983	618,800	45,000	50,800	141,700	100,300	7,500	82,900	25,200	20,400	1,063,300
1984	635,200	46,600	50,900	150,100	102,200	8,300	85,000	23,900	20,600	1,122,800
1985	651,800	48,100	51,000	159,100	104,300	9,200	87,200	22,700	20,400	1,153,800

new roles, and increased use of nurses in extender or practitioner roles in physician offices. The processes by which these concepts affect the requirements for nurses in the affected settings were described in appendix A. The following subsections describe the manner in which the parameters governing these processes were obtained.

Primary Nursing

The most significant personnel impact of PN appears to be the replacement of nursing assistants, aides, and orderlies with licensed nurses—either RNs or LPNs. Data from primary nursing units [Manthey, 1973; Manthey and Kramer,

APPENDIX B

Table B-13.—Detailed results, high HMO growth scenario

PROJECTED SERVICE DEMANDS (000's)

Year	Patient days	Outpatient visits	Office visits	Type 1 NH days	Type 2 NH days	Home visits	HMO clinic visits
1972	342,319.	164,060.	638,606.	329,548.	66,648.	32,434.	17,555.
1973	346,307.	173,019.	649,343.	367,126.	63,961.	32,941.	20,799.
1974	350,417.	182,058.	660,136.	406,117.	61,174.	33,483.	24,096.
1975	354,480.	191,002.	670,400.	447,151.	58,302.	34,048.	27,933.
1976	358,246.	199,843.	680,080.	488,079.	55,089.	34,535.	32,455.
1977	361,971.	208,579.	689,604.	529,653.	51,635.	34,996.	37,541.
1978	365,749.	217,567.	699,204.	573,121.	48,070.	35,473.	43,113.
1979	369,443.	226,426.	708,789.	617,066.	44,307.	35,935.	49,127.
1980	373,142.	235,304.	718,328.	662,460.	40,406.	36,388.	55,627.
1981	376,734.	244,162.	727,700.	707,657.	36,278.	36,816.	62,643.
1982	380,199.	252,900.	736,682.	753,507.	31,966.	37,228.	70,218.
1983	383,583.	261,448.	745,123.	800,816.	27,592.	37,668.	78,391.
1984	386,947.	269,830.	753,113.	851,011.	23,099.	38,149.	87,213.
1985	390,323.	277,965.	760,492.	905,041.	18,497.	38,703.	96,738.

PROJECTED REQUIREMENTS FOR FULL-TIME EQUIVALENT REGISTERED NURSES

Year	Short-term inpatient	Hospital outpatient	Physician office	Nursing homes	Community health	HMO clinic	Other hospitals	Private duty + misc	Educators	Total
1972	385,300	23,800	42,000	50,200	73,900	1,700	56,500	37,700	21,500	692,700
1973	397,500	25,100	42,300	55,100	75,800	2,100	58,500	35,900	21,300	713,300
1974	409,900	26,400	42,300	60,300	77,600	2,400	60,500	34,100	20,800	734,400
1975	422,500	27,700	42,400	65,800	79,500	2,800	62,600	32,400	20,400	756,000
1976	435,000	29,000	42,500	71,200	81,300	3,200	64,600	30,700	19,900	777,500
1977	447,500	30,300	42,400	76,700	83,100	3,700	66,600	29,200	19,700	799,300
1978	460,200	31,600	42,300	82,400	85,000	4,300	68,700	27,700	19,400	821,600
1979	473,100	32,900	42,300	88,200	86,800	4,900	70,700	26,400	19,200	844,400
1980	486,100	34,200	42,300	94,200	88,600	5,500	72,700	25,000	18,900	867,500
1981	499,100	35,500	42,300	100,200	90,400	6,200	74,700	23,800	18,500	890,700
1982	512,100	36,700	42,300	106,200	92,200	7,000	76,800	22,600	18,300	914,100
1983	525,100	38,000	42,100	112,400	94,100	7,800	78,800	21,500	18,300	938,000
1984	538,200	39,200	41,900	119,000	95,900	8,700	80,800	20,400	18,400	962,700
1985	551,600	40,400	41,700	126,200	97,800	9,800	82,900	19,400	18,200	987,600

PROJECTED REQUIREMENTS FOR TOTAL EMPLOYED REGISTERED NURSES

Year	Short-term inpatient	Hospital outpatient	Physician office	Nursing homes	Community health	HMO clinic	Other hospitals	Private duty + misc	Educators	Total
1972	450,800	27,800	48,700	63,300	78,800	2,000	59,400	44,100	23,200	798,100
1973	465,100	29,300	48,900	69,500	80,800	2,400	61,500	42,000	23,000	822,500
1974	479,800	30,800	49,000	76,000	82,700	2,800	63,600	39,900	22,400	846,800
1975	494,300	32,300	49,100	83,000	84,700	3,200	66,900	37,900	22,000	872,400
1976	508,900	33,800	49,300	89,800	86,700	3,700	68,000	35,900	21,500	897,600
1977	523,600	35,400	49,100	96,700	88,600	4,300	70,100	34,200	21,300	923,300
1978	538,400	36,900	49,000	103,900	90,600	5,000	72,300	32,400	20,900	949,400
1979	553,500	38,400	49,000	111,200	92,500	5,700	74,400	30,900	20,700	976,300
1980	568,700	39,900	49,000	118,800	94,400	6,400	76,500	29,200	20,400	1,003,300
1981	583,900	41,400	48,900	126,400	96,400	7,200	78,600	27,800	20,000	1,030,800
1982	599,200	42,800	48,900	133,900	98,300	8,100	80,800	26,400	19,700	1,058,100
1983	614,400	44,300	48,800	141,700	100,300	9,000	82,900	25,200	19,700	1,086,300
1984	629,700	45,700	48,600	150,100	102,200	10,100	85,000	23,900	19,900	1,115,200
1985	645,400	47,100	48,300	159,100	104,300	11,100	87,200	22,700	19,800	1,144,800

1970; Logsdon, 1973; and Felton, 1975] indicate the average RN/aide and LPN/aide ratios in these units are 2 and 1.19 respectively. These are slightly more than double the ratios expected in typical inpatient units currently.[16] In PN units employing only RNs, the increased number of RNs employed depends on the relative productivities of the former members of the nursing team.[17] As a conservative measure, the analysis assumes relative productivities in such units are proportional

[16]There are, however, indications that changes in staffing patterns are not always necessary with the introduction of the concept [Manthey, 1973; and Manthey and Kramer, 1970].

[17]Clearly, it also depends on many other factors such as the size of the inpatient unit and the mix of patients. We have assumed such factors remain approximately the same when a unit converts from team nursing to primary nursing.

to the relative wages which result in RN/LPN and RN/aide ratios of 1.25 and 1.73, respectively.[18]

The concept of PN seems destined to increase in acceptance because of its many advantages. Cisbe [1974] cites reduced turnover rates, while Daeffler [1975a] and Marram, Schlegal, and Davis [1974] report increased patient satisfaction. Also, some evidence has developed suggesting possible increases in quality of care.[19] Thus, while some growth appears to be inevitable, the rate of growth is itself less evident. Based on personal communications with persons familiar with primary nursing, the analysis assumes that about 3 percent of inpatient units currently employ primary nursing, and that widespread acceptance of the concept could not occur prior to 1985. This latter assumption is in part based on the fact that team nursing took about a decade to be adopted. Further, since it seems unlikely that all inpatient units would adopt this concept, the maximum fraction of PN units in 1985 is assumed to be about 80 percent, while the minimum would be about 10 percent, in view of the advantages cited. A "reasonable" moderate value, between the two extremes, was judged to be about 40 percent. From similar considerations and discussions, it was estimated that reasonable low, moderate, and high values of the fraction of PN units using RNs exclusively by 1985 were 5, 15, and 35 percent, respectively. This is based on our discussions with nursing experts, and the fact that currently this interpretation of the PN concept is far from predominant.

New Roles for Clinical Nurse Specialists

Clinical nurse specialists are nurses with master's degrees, having research or advanced clinical practice as a purpose rather than teaching or administration.[20] Essentially, they may be viewed as RNs with an additional degree. The use of clinical nurse specialists in hospitals is not new, of course. However, when CNSs are employed in new or "reformulated" roles, the ranks of RNs are correspondingly depleted, assuming that the new roles do not overlap with the existing duties of RNs.

To determine the extent of this impact, one must determine the number of CNSs employed in hospitals in advanced clinical practice, and the fraction of those who enter reformulated roles. On the basis of trends indicated in American Nurses' Association [1974], the future number of nurses is readily projected. Also on the basis of data from this source, we assumed about 45 percent of these went into advanced clinical practice, and of these about two-thirds became employed in short-term general hospital inpatient units. Unfortunately, there are no data regarding the function of these newly employed graduate nurses who enter "new" roles and thus of the number of new RN requirements. Because the total annual number of newly employed graduate nurses in hospitals in advanced clinical practice are so small,[21] assumptions concerning the growth of this type of role reformulation have limited impact on nurse requirements. Consequently, to encompass the range of potential impacts, the analysis assumed the fraction of CNSs employed in new roles in 1985 to be, at most, 100 percent and at least, 50 percent. The impact of a moderate value of 75 percent was also examined.

Nurses in Practitioner Roles in Physician Offices

As the demand for ambulatory services increases, the need can be met in three ways: by increasing the supply of physicians, by increasing the productivity of the office practice, and by utilizing nonphysician personnel to satisfy a part (or all) of the "excess" visits demanded. Analysis of data from Reinhardt [1970] concerning the productivity of physician office practice by specialty, together with information on physician's fees, yielded an estimate that a physician can economically employ no more than four employees (receptionists, nurses, aides, etc.). Then, using distribution of physician office practice sizes, and assuming limits on the maximum number of hours physicians are willing to work, parameters were developed for the physician office submodel which allowed the calculation of the quantity of office visits which could be satisfied by conventional practice arrangements.

The remainder of the required quantity of office services are then assumed to be satisfied by nonphysician personnel or remain unsatisfied. The

[18] Using November 1974 data from American Hospital Association [1975b].

[19] As measured by such procedures as the Slater Nursing Competency Scale, the Quality Patient Care Scale, and the Phaneuf Nursing Audit; see Felton [1975].

[20] In the base year, about 45 percent of nurses with newly earned master's degrees had advanced clinical practice as their functional purpose [American Hospital Association, 1974].

[21] There are fewer than 1,000 in the base year, compared to almost 700,000 full-time equivalent RNs employed.

nonphysician personnel could be nurses, physician assistants, or other midlevel health workers functioning in extended roles. The fraction of these services provided by formal nurse practitioners or nurses informally functioning in practitioner roles is a highly speculative matter. There are only extremely sparse data on the number of nurses currently employed in such roles and no data on which to establish a trend for the future. The value of this parameter is dependent, among other things, on the future supply of nurses and physicians' assistants trained for these roles, and on the degree of licensing restrictions and regulations imposed by the States on such practice. A rough estimate of the current fraction of such visits provided by nurses in practitioner roles is about 20 percent. To demonstrate the range of potential impact of growth in this parameter, results were computed for growths from the 20-percent base year value to low, moderate, and high values of 35, 65, and 100 percent in 1985, respectively.

Utilizing the quantity of services provided by nurses in practitioner roles, calculated as discussed above, the actual number of nurses required to provide these services was determined. This was done by using the results of various studies that measured the productivity of such personnel in physicians' offices, relative to that of the physician. The results of these studies[22] indicates a range of 38 percent to 80 percent, with an average productivity of about 54 percent of that of the physician.

[22]See Zeckhauser and Eliastam, 1974; Pondy, 1972; Smith, Miller, and Golladay, 1972; Schiff, Fraser, and Walters, 1969; and Druin and Chamberlain, 1975.

Role Reformulation Scenarios

In the previous discussion, four parameters were rated as determining the growth of role reformulation concepts. Each of these parameters is a fraction that specifies a measure of the acceptance of a particular role reformulation concept by the end of the projection period, 1985. To test the impact of role reformulation on nurse requirements over the range of these parameters, four scenarios were defined representing no increase in acceptance,[23] highest probable acceptance, and two points between representing low and moderate acceptance. Based on this concept, the values of the four parameters derived as discussed above are summarized in table B-14 below.

The first scenario, a "no-growth" scenario, has, in effect, already been presented as the norm for health insurance analysis. The other three are presented in tables B-15, B-16, and B-17. Included with the aggregate service demands and the nurse requirements estimates are separate projections showing the impact of role reformulation in each scenario. The first two columns of the tabulated "Effect of Role Reformulation . . ." in all three tables show the influence of primary nursing in hospitals on RN and LPN requirements, while the third shows the influence of increases in new roles for clinical nurse specialists on RN requirements. The fourth column shows the impact of primary nursing on requirements for nursing aides, while the last column shows the impact of growth in

[23]No increase in acceptance is intended to mean a value in 1985 equivalent to the base year value.

Table B-14.—Role reformulation scenario parameter values

Parameter	Scenario type			
	No growth (base year values)	Low growth	Moderate growth	High growth
Fraction of inpatient units with primary nursing by 1985	0.03	0.10	0.40	0.80
Fraction of primary nursing units using RNs only by 1985	0.00	0.05	0.15	0.35
Fraction of clinical nurse specialist roles new by 1985	0.00	0.50	0.75	1.00
Fraction of unsatisfied office visits provided by nurses in practitioner roles by 1985	0.20	0.35	0.65	1.00

Table B-15.—Detailed results, low growth in role reformulation

PROJECTED SERVICE DEMANDS (000's)

Year	Patient days	Outpatient visits	Office visits	Type 1 NH days	Type 2 NH days	Home visits	HMO clinic visits
1972	242,319.	164,060.	838,566.	329,848.	66,648.	32,424.	17,555.
1973	246,307.	173,019.	849,343.	367,126.	63,961.	32,941.	20,799.
1974	250,417.	182,058.	860,138.	406,117.	61,174.	33,483.	24,096.
1975	254,586.	191,178.	871,196.	447,151.	58,302.	34,049.	27,250.
1976	258,637.	200,403.	882,504.	488,080.	55,069.	34,535.	30,289.
1977	262,770.	209,857.	894,583.	529,853.	51,635.	34,996.	33,289.
1978	267,066.	219,563.	907,419.	573,121.	48,070.	35,473.	36,065.
1979	271,355.	229,424.	920,690.	617,086.	44,307.	35,925.	38,900.
1980	275,699.	239,428.	934,271.	662,460.	40,406.	36,388.	41,984.
1981	279,987.	249,577.	948,092.	707,657.	36,378.	36,816.	45,237.
1982	284,206.	259,721.	961,671.	753,808.	31,996.	37,228.	48,770.
1983	288,403.	269,864.	975,251.	800,818.	27,592.	37,668.	52,570.
1984	292,646.	280,025.	988,771.	851,011.	23,099.	38,149.	56,661.
1985	296,974.	290,138.	1,002,132.	905,041.	18,497.	38,708.	61,089.

PROJECTED REQUIREMENTS FOR FULL-TIME EQUIVALENT REGISTERED NURSES

Year	Short-term inpatient	Hospital outpatient	Physician office	Nursing homes	Community health	HMO clinic	Other hospitals	Private duty + misc	Educators	Total
1972	385,300	23,800	42,000	50,200	73,900	1,700	56,500	37,700	21,800	693,000
1973	397,700	25,100	42,300	55,100	75,800	2,100	58,500	35,900	21,600	714,000
1974	410,600	26,400	42,600	60,300	77,600	2,400	60,500	34,100	21,300	735,800
1975	423,700	27,800	42,900	65,800	79,500	2,700	62,600	32,400	21,000	756,300
1976	436,900	29,100	43,300	71,200	81,200	3,000	64,600	30,700	20,800	781,000
1977	450,500	30,500	43,800	76,700	83,100	3,300	66,600	29,200	20,800	804,400
1978	464,500	31,900	44,200	82,400	85,000	3,600	68,700	27,700	20,600	828,600
1979	478,900	33,300	44,700	88,200	86,800	3,900	70,700	26,400	20,500	853,300
1980	493,800	34,800	45,300	94,200	88,600	4,200	72,700	25,000	20,200	878,500
1981	508,400	36,200	45,900	100,200	90,400	4,500	74,700	23,800	19,900	904,000
1982	523,400	37,700	46,500	106,200	92,200	4,800	76,800	22,600	19,800	930,000
1983	538,600	39,300	47,100	112,400	94,100	5,200	78,800	21,500	19,900	956,700
1984	554,100	40,700	47,600	119,000	95,900	5,600	80,800	20,400	20,200	984,400
1985	570,100	42,100	48,200	126,200	97,800	6,100	82,900	19,400	20,000	1,012,700

PROJECTED REQUIREMENTS FOR TOTAL EMPLOYED REGISTERED NURSES

Year	Short-term inpatient	Hospital outpatient	Physician office	Nursing homes	Community health	HMO clinic	Other hospitals	Private duty + misc	Educators	Total
1972	450,800	27,800	46,700	63,300	78,800	2,000	59,400	44,100	23,500	796,400
1973	465,300	29,300	49,000	69,500	80,800	2,400	61,500	42,000	23,300	823,100
1974	480,400	30,800	49,400	76,000	82,700	2,800	63,600	39,900	23,000	848,600
1975	495,700	32,400	49,700	83,000	84,700	3,100	65,900	37,900	22,700	875,100
1976	511,200	34,000	50,200	89,800	86,700	3,500	68,000	35,900	22,400	901,700
1977	527,100	35,600	50,800	96,700	88,600	3,800	70,100	34,200	22,400	929,300
1978	543,500	37,200	51,200	103,900	90,600	4,200	72,300	32,400	22,200	957,500
1979	560,300	38,900	51,800	111,200	92,500	4,500	74,400	30,900	22,100	986,600
1980	577,400	40,600	52,500	118,800	94,400	4,900	76,500	29,200	21,800	1,016,100
1981	594,800	42,200	53,200	126,400	96,400	5,200	78,600	27,800	21,500	1,046,100
1982	612,400	44,000	53,900	133,900	98,300	5,600	80,800	26,400	21,400	1,076,700
1983	630,200	45,700	54,600	141,700	100,300	6,000	82,900	25,200	21,500	1,108,100
1984	648,300	47,500	55,200	150,100	102,200	6,500	85,000	23,900	21,800	1,140,500
1985	667,000	49,100	55,900	159,100	104,300	7,100	87,200	22,700	21,600	1,174,000

EFFECT OF ROLE REFORMULATION ON FTE NURSE REQUIREMENTS
ASSUMING PRODUCTIVITY PROPORTIONAL TO WAGES

Year	RNS	LPNS	CNS	Aides	NPS
1972	1,069.	1,039.	0.	-3,202.	2,456.
1973	1,474.	1,230.	27.	-4,114.	2,558.
1974	1,900.	1,374.	58.	-5,036.	2,657.
1975	2,369.	1,467.	92.	-5,970.	2,756.
1976	2,881.	1,506.	131.	-6,910.	2,855.
1977	3,441.	1,484.	174.	-7,861.	2,966.
1978	4,054.	1,403.	222.	-8,826.	3,069.
1979	4,719.	1,256.	276.	-9,800.	3,220.
1980	5,440.	1,040.	335.	-10,786.	3,357.
1981	6,219.	750.	402.	-11,779.	3,498.
1982	7,057.	384.	475.	-12,778.	3,638.
1983	7,957.	-63.	556.	-13,785.	3,776.
1984	8,924.	-595.	645.	-14,803.	3,914.
1985	9,963.	-1,216.	743.	-15,835.	4,048.

Table B-16.—Detailed results, moderate growth in role reformulation

PROJECTED SERVICE DEMANDS (000's)

Year	Patient days	Outpatient visits	Office visits	Type 1 NH days	Type 2 NH days	Home visits	HMO clinic visits
1972	242,319.	164,060.	838,566.	329,848.	66,648.	32,424.	17,555.
1973	246,307.	173,019.	849,343.	367,126.	63,961.	32,941.	20,799.
1974	250,417.	182,058.	860,138.	406,117.	61,174.	33,483.	24,096.
1975	254,586.	191,178.	871,196.	447,151.	58,302.	34,049.	27,250.
1976	258,627.	200,403.	882,504.	488,080.	55,089.	34,535.	30,359.
1977	262,770.	209,857.	894,583.	529,853.	51,635.	34,996.	33,289.
1978	267,066.	219,563.	907,419.	573,121.	48,070.	35,473.	36,065.
1979	271,355.	229,424.	920,690.	617,086.	44,307.	35,925.	38,900.
1980	275,688.	239,428.	934,271.	662,460.	40,406.	36,388.	41,954.
1981	279,987.	249,577.	948,002.	707,657.	36,278.	36,816.	45,237.
1982	284,206.	259,721.	961,671.	753,508.	31,995.	37,228.	48,770.
1983	288,403.	269,864.	975,251.	800,818.	27,592.	37,668.	52,570.
1984	292,646.	280,025.	988,771.	851,011.	23,099.	38,149.	56,661.
1985	296,974.	290,138.	1,002,132.	905,041.	18,497.	38,703.	61,069.

PROJECTED REQUIREMENTS FOR FULL-TIME EQUIVALENT REGISTERED NURSES

Year	Short-term inpatient	Hospital outpatient	Physician office	Nursing homes	Community health	HMO clinic	Other hospitals	Private duty + misc	Educators	Total
1972	385,300	23,800	42,000	50,200	73,900	1,700	56,500	37,700	22,800	694,000
1973	396,800	25,100	42,600	55,100	75,800	2,100	58,500	35,900	22,700	716,600
1974	413,000	26,400	43,200	60,300	77,600	2,400	60,500	34,100	22,500	740,000
1975	427,800	27,800	43,800	65,800	79,500	2,700	62,600	32,400	22,400	764,600
1976	443,000	29,100	44,400	71,200	81,300	3,000	64,600	30,700	22,300	789,600
1977	458,900	30,500	45,100	76,700	83,100	3,300	66,600	29,200	22,300	815,700
1978	475,600	31,900	45,800	82,400	85,000	3,600	68,700	27,700	22,200	842,900
1979	492,900	33,300	46,800	88,200	86,800	3,900	70,700	26,400	22,300	871,100
1980	511,100	34,800	47,400	94,200	88,600	4,200	72,700	25,000	22,100	900,100
1981	529,800	36,200	48,300	100,200	90,400	4,500	74,700	23,800	22,000	929,900
1982	549,100	37,700	49,100	106,200	92,200	4,800	76,800	22,600	22,100	960,700
1983	569,100	39,200	50,000	112,400	94,100	5,200	78,800	21,500	22,400	992,600
1984	590,000	40,700	50,800	119,000	95,900	5,600	80,800	20,400	22,800	1,026,000
1985	611,800	42,100	51,700	126,200	97,800	6,100	82,900	19,400	22,800	1,060,600

PROJECTED REQUIREMENTS FOR TOTAL EMPLOYED REGISTERED NURSES

Year	Short-term inpatient	Hospital outpatient	Physician office	Nursing homes	Community health	HMO clinic	Other hospitals	Private duty + misc	Educators	Total
1972	460,800	27,800	48,700	63,300	78,800	2,000	59,400	44,100	24,600	799,500
1973	466,800	29,300	49,400	69,500	80,800	2,400	61,500	42,000	24,500	826,000
1974	483,200	30,800	50,100	76,000	82,700	2,800	63,600	39,900	24,300	853,400
1975	500,500	32,400	50,800	83,000	84,700	3,100	65,900	37,900	24,200	882,500
1976	518,300	34,000	51,500	89,800	86,700	3,500	68,000	35,900	24,100	911,800
1977	536,900	35,600	52,300	96,700	88,600	3,800	70,100	34,200	24,100	942,300
1978	556,500	37,200	53,100	103,900	90,600	4,200	72,300	32,400	24,000	974,200
1979	576,700	38,900	54,000	111,200	92,500	4,500	74,400	30,900	24,100	1,007,200
1980	598,000	40,600	54,900	118,500	94,400	4,900	76,500	29,200	23,800	1,041,100
1981	619,900	42,200	56,000	126,400	96,400	5,200	78,600	27,800	23,700	1,076,200
1982	642,400	44,000	56,900	133,900	98,300	5,600	80,800	26,400	23,800	1,112,100
1983	665,800	45,700	57,900	141,700	100,300	6,000	82,900	25,200	24,200	1,149,700
1984	690,300	47,500	58,900	150,100	102,200	6,500	85,000	23,900	24,600	1,189,000
1985	715,800	49,100	59,900	159,100	104,300	7,100	87,200	22,700	24,600	1,229,800

EFFECT OF ROLE REFORMULATION ON FTE NURSE REQUIREMENTS ASSUMING PRODUCTIVITY PROPORTIONAL TO WAGES

Year	RNS	LPNS	CNS	Aides	NPS
1972	1,089.	1,039.	0.	-3,202.	2,456.
1973	2,567.	1,925.	41.	-6,887.	2,837.
1974	4,348.	2,507.	87.	-10,718.	3,207.
1975	6,458.	2,759.	138.	-14,707.	3,569.
1976	8,915.	2,655.	196.	-18,850.	3,926.
1977	11,749.	2,170.	261.	-23,171.	4,294.
1978	14,994.	1,277.	333.	-27,691.	4,677.
1979	18,667.	-55.	414.	-32,408.	5,072.
1980	22,803.	-1,853.	503.	-37,341.	5,477.
1981	27,419.	-4,148.	602.	-42,488.	5,889.
1982	32,542.	-6,966.	712.	-47,854.	6,300.
1983	38,203.	-10,339.	833.	-53,459.	6,709.
1984	44,439.	-14,299.	967.	-59,327.	7,116.
1985	51,291.	-18,882.	1,115.	-65,483.	7,519.

Table B-17.—Detailed results, high growth in role reformulation

PROJECTED SERVICE DEMANDS (000's)

Year	Patient days	Outpatient visits	Office visits	Type 1 NH days	Type 2 NH days	Home visits	HMO clinic visits
1972	242,319.	164,060.	838,566.	329,848.	66,648.	32,424.	17,555.
1973	246,307.	173,019.	849,343.	367,126.	63,961.	32,941.	20,799.
1974	250,417.	182,058.	860,138.	406,117.	61,174.	33,483.	24,096.
1975	254,588.	191,178.	871,196.	447,151.	58,302.	34,049.	27,250.
1976	258,637.	200,403.	882,504.	488,080.	55,069.	34,535.	30,359.
1977	262,770.	209,857.	894,583.	529,853.	51,635.	34,996.	33,289.
1978	267,066.	219,563.	907,419.	573,121.	48,070.	35,473.	36,065.
1979	271,355.	229,424.	920,690.	617,088.	44,307	35,925.	38,900.
1980	275,699.	239,428.	934,271.	662,460.	40,406.	36,388.	41,954.
1981	279,987.	249,577.	948,002.	707,657.	36,278.	36,816.	45,237.
1982	284,206.	259,721.	961,671.	753,508.	31,995.	37,228.	48,770.
1983	288,403.	269,864.	975,251.	800,818.	27,592.	37,668.	52,570.
1984	292,646.	280,025.	988,771.	851,011.	23,099.	38,149.	56,661.
1985	296,974.	290,138.	1,002,132.	905,041.	18,497.	38,703.	61,089.

PROJECTED REQUIREMENTS FOR FULL-TIME EQUIVALENT REGISTERED NURSES

Year	Short-term inpatient	Hospital outpatient	Physician office	Nursing homes	Community health	HMO clinic	Other hospitals	Private duty + misc	Educators	Total
1972	385,300	23,800	42,000	50,200	73,900	1,700	56,500	37,700	24,300	695,500
1973	400,600	25,100	42,900	55,100	75,800	2,100	58,500	35,900	24,500	720,500
1974	417,500	26,400	43,800	60,300	77,600	2,400	60,500	34,100	24,700	747,300
1975	435,900	27,800	44,700	65,800	79,500	2,700	62,600	32,400	25,000	776,300
1976	455,700	29,100	45,600	71,200	81,300	3,000	64,600	30,700	25,400	806,700
1977	477,400	30,500	46,600	76,700	83,100	3,300	66,600	29,200	25,900	839,400
1978	501,200	31,900	47,600	82,400	85,000	3,600	63,700	27,700	26,300	874,400
1979	527,000	33,300	48,800	88,200	86,800	3,900	70,700	26,400	26,900	911,800
1980	554,900	34,800	49,900	94,200	88,600	4,200	72,700	25,000	27,200	951,600
1981	585,000	36,200	51,100	100,200	90,400	4,500	74,700	23,800	27,700	993,600
1982	617,200	37,700	52,200	106,200	92,200	4,800	76,800	22,600	28,300	1,038,100
1983	651,900	39,200	53,400	112,400	94,100	5,200	78,800	21,500	29,200	1,085,600
1984	689,200	40,700	54,600	119,000	95,900	5,600	80,800	20,400	30,200	1,136,500
1985	729,500	42,100	55,700	125,200	97,800	6,100	82,900	19,400	30,700	1,190,400

PROJECTED REQUIREMENTS FOR TOTAL EMPLOYED REGISTERED NURSES

Year	Short-term inpatient	Hospital outpatient	Physician office	Nursing homes	Community health	HMO clinic	Other hospitals	Private duty + misc	Educators	Total
1972	450,800	27,800	48,700	63,300	78,800	2,000	59,400	44,100	26,200	801,100
1973	468,700	29,300	49,700	69,500	80,800	2,400	61,500	42,000	26,400	830,300
1974	488,500	30,800	50,800	76,000	82,700	2,800	63,600	39,900	26,700	861,800
1975	510,000	32,400	51,800	83,000	84,700	3,100	65,900	37,900	27,000	895,800
1976	533,200	34,000	52,900	89,800	86,700	3,500	68,000	35,900	27,400	931,400
1977	558,600	35,600	54,000	96,700	88,600	3,800	70,100	34,200	27,900	969,500
1978	586,400	37,200	55,200	103,900	90,600	4,200	72,300	32,400	28,400	1,010,600
1979	616,600	38,900	56,600	111,200	92,500	4,500	74,400	30,900	29,000	1,054,600
1980	649,200	40,600	57,800	118,800	94,400	4,900	76,500	29,200	29,300	1,100,700
1981	684,400	42,200	59,200	126,400	96,400	5,200	78,600	27,800	29,900	1,150,100
1982	722,100	44,000	60,500	133,900	98,300	5,600	80,800	26,400	30,500	1,202,100
1983	762,700	45,700	61,900	141,700	100,300	6,000	82,900	25,200	31,500	1,257,900
1984	806,400	47,500	63,300	150,100	102,200	6,500	85,000	23,900	32,600	1,317,500
1985	853,500	49,100	64,600	159,100	104,300	7,100	87,200	22,700	33,100	1,380,700

EFFECT OF ROLE REFORMULATION ON FTE NURSE REQUIREMENTS
ASSUMING PRODUCTIVITY PROPORTIONAL TO WAGES

Year	RNS	LPNS	CNS	Aides	NPS
1972	1,089.	1,039.	0.	-3,202.	2,456.
1973	4,316.	2,609.	54.	-10,788.	3,163.
1974	8,739.	3,086.	116.	-19,076.	3,848.
1975	14,462.	2,373.	185.	-28,128.	4,518.
1976	21,583.	369.	262.	-37,981.	5,176.
1977	30,222.	-3,027.	348.	-48,720.	5,843.
1978	40,510.	-7,927.	445.	-60,436.	6,531.
1979	52,553.	-14,439.	552.	-73,170.	7,233.
1980	66,485.	-22,681.	671.	-87,009.	7,951.
1981	82,407.	-32,763.	803.	-101,990.	8,678.
1982	100,433.	-44,793.	949.	-118,173.	9,405.
1983	120,701.	-58,895.	1,111.	-135,646.	10,130.
1984	143,372.	-75,203.	1,290.	-154,516.	10,852.
1985	168,616.	-93,863.	1,486.	-174,895.	11,567.

acceptance of nurses in practitioner roles in physician offices. As would be expected from the definition of the primary nursing concept and the model parameters, the data show that, as the concept grows in acceptance, requirements for both RNs and LPNs increase at the expense of requirements for aides. However, as the fraction of inpatient, primary nursing units utilizing RNs exclusively also increases, the requirements for LPNs decline to a level lower than they would have without primary nursing.

Combinations of Health System Changes

As discussed earlier in chapter 6 of this report, the most realistic scenarios examined are those consisting of combinations of health system changes. Since the model is designed to reflect real life, we expect and indeed find that the total impact of combinations of changes is not simply obtained by adding the impacts of the changes determined separately, as in the preceding chapters or the appendix. Thus, a number of combined scenarios were devised, of which three are presented here.

The parameter values for the combined scenarios are not individually different from those defined earlier. Consequently, they will not be discussed further here, but are summarized below.

Combined Scenario Assumptions

Combination 1
- "Norm" NHI scenario
- Low HMO growth scenario
- Low role reformulation scenario

Combination 2
- NHI 1 scenario
- Moderate HMO growth scenario
- Moderate role reformulation scenario

Combination 3
- NHI 2 scenario
- High HMO growth scenario
- High role reformulation scenario

The results for these scenarios are presented in tables B-18, B-19, and B-20.

Table B-16.—Detailed results, low combined scenario

PROJECTED SERVICE DEMANDS (000's)

Year	Patient days	Outpatient visits	Office visits	Type 1 NH days	Type 2 NH days	Home visits	HMO clinic visits
1972	242,319.	164,060.	838,566.	329,848.	66,648.	32,424.	17,555.
1973	248,307.	173,019.	849,343.	367,126.	63,961.	32,941.	20,799.
1974	250,417.	182,068.	860,138.	406,117.	61,174.	33,483.	24,096.
1975	254,588.	191,178.	871,196.	447,151.	58,302.	34,049.	27,350.
1976	258,637.	200,403.	882,504.	489,080.	55,069.	34,535.	30,359.
1977	262,770.	209,857.	894,583.	529,353.	51,635.	34,996.	33,269.
1978	267,066.	219,563.	907,419.	573,121.	48,070.	35,473.	36,065.
1979	271,355.	229,424.	920,690.	617,088.	44,307.	35,925.	38,900.
1980	275,699.	239,428.	934,271.	662,460.	40,406.	36,388.	41,964.
1981	279,967.	249,577.	948,002.	707,657.	36,278.	36,816.	45,237.
1982	284,206.	259,721.	961,971.	753,508.	31,995.	37,228.	48,770.
1983	288,403.	269,864.	975,251.	800,818.	27,592.	37,668.	52,570.
1984	292,646.	280,025.	988,771.	851,011.	23,099.	38,149.	56,661.
1985	296,974.	290,138.	1,002,132.	905,041.	18,497.	38,703.	61,069.

PROJECTED REQUIREMENTS FOR FULL-TIME EQUIVALENT REGISTERED NURSES

Year	Short-term inpatient	Hospital outpatient	Physician office	Nursing homes	Community health	HMO clinic	Other hospitals	Private duty+misc	Educators	Total
1972	385,300	23,800	42,000	50,300	73,900	1,700	56,500	37,700	21,800	693,000
1973	397,700	25,100	42,300	55,100	75,800	2,100	58,500	38,900	21,600	714,000
1974	410,800	26,400	42,600	60,300	77,600	2,400	60,500	34,100	21,300	735,800
1975	423,700	27,800	42,900	65,800	79,500	2,700	62,600	32,400	21,000	758,300
1976	436,900	29,100	43,300	71,200	81,300	3,000	64,600	30,700	20,800	781,000
1977	450,500	30,500	43,600	76,700	83,100	3,300	66,600	29,200	20,800	804,400
1978	464,500	31,900	44,200	82,400	85,000	3,600	68,700	27,700	20,600	828,600
1979	478,900	33,300	44,700	88,200	86,800	3,900	70,700	26,400	20,500	853,300
1980	493,500	34,800	45,300	94,200	88,600	4,200	72,700	25,000	20,200	878,500
1981	508,400	36,200	45,900	100,300	90,400	4,500	74,700	23,800	19,900	904,000
1982	523,400	37,700	46,500	106,200	92,200	4,800	76,800	22,600	19,800	930,000
1983	539,600	39,200	47,100	112,400	94,100	5,200	78,800	21,500	19,900	956,700
1984	554,100	40,700	47,600	119,000	95,900	5,600	80,800	20,400	20,200	984,400
1985	570,100	42,100	48,200	126,200	97,800	6,100	82,900	19,400	20,000	1,012,700

PROJECTED REQUIREMENTS FOR TOTAL EMPLOYED REGISTERED NURSES

Year	Short-term inpatient	Hospital outpatient	Physician office	Nursing homes	Community health	HMO clinic	Other hospitals	Private duty+misc	Educators	Total
1972	450,800	27,800	48,700	63,300	78,800	2,000	59,400	44,100	23,500	798,400
1973	465,300	29,300	49,000	69,500	80,800	2,400	61,500	42,000	23,300	823,100
1974	480,400	30,800	49,400	76,000	82,700	2,800	63,800	39,900	23,000	848,600
1975	496,700	32,400	49,700	83,000	84,700	3,100	65,900	37,900	22,700	875,100
1976	511,200	34,000	50,200	89,800	86,700	3,500	68,000	35,900	22,400	901,700
1977	527,100	35,600	50,800	96,700	88,600	3,800	70,100	34,200	22,400	929,200
1978	543,500	37,200	51,200	103,900	90,600	4,200	72,300	32,400	23,200	957,500
1979	560,300	38,900	51,800	111,200	92,500	4,500	74,400	30,900	22,100	986,600
1980	577,400	40,600	52,500	118,800	94,400	4,900	76,500	29,200	21,800	1,016,100
1981	594,800	42,200	53,200	126,400	96,400	5,200	78,600	27,800	21,500	1,046,100
1982	612,400	44,000	53,900	133,900	98,300	5,600	80,800	26,400	21,400	1,076,700
1983	630,200	45,700	54,600	141,700	100,300	6,000	82,900	25,200	21,500	1,108,100
1984	648,300	47,500	55,200	150,100	102,200	6,500	85,000	23,900	21,800	1,140,500
1985	667,000	49,100	55,900	159,100	104,300	7,100	87,200	22,700	21,600	1,174,000

EFFECT OF ROLE REFORMULATION ON FTE NURSE REQUIREMENTS ASSUMING PRODUCTIVITY PROPORTIONAL TO WAGES

Year	RNS	LPNS	CNS	Aides	NPS
1972	1,089.	1,039.	0.	-3,202.	2,456.
1973	1,474.	1,230.	27.	-4,114.	2,558.
1974	1,900.	1,374.	58.	-5,036.	2,657.
1975	2,369.	1,467.	92.	-5,970.	2,756.
1976	2,881.	1,505.	131.	-6,910.	2,855.
1977	3,441.	1,484.	174.	-7,861.	2,966.
1978	4,054.	1,403.	222.	-8,826.	3,089.
1979	4,719.	1,256.	276.	-9,800.	3,220.
1980	5,440.	1,040.	335.	-10,786.	3,357.
1981	6,219.	750.	402.	-11,779.	3,498.
1982	7,057.	384.	475.	-12,778.	3,638.
1983	7,957.	-63.	556.	-13,785.	3,776.
1984	8,924.	-596.	645.	-14,803.	3,914.
1985	9,963.	-1,216.	743.	-15,835.	4,048.

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Table B-19.—Detailed results, moderate combined scenario

PROJECTED SERVICE DEMANDS (000's)

Year	Patient days	Outpatient visits	Office visits	Type 1 NH days	Type 2 NH days	Home visits	HMO clinic visits
1972	242,317.	164,058.	838,563.	329,848.	66,648.	32,424.	17,555.
1973	246,305.	173,016.	849,341.	367,126.	63,961.	32,941.	20,799.
1974	250,415.	182,055.	860,136.	406,117.	61,174.	33,483.	24,096.
1975	254,521.	191,086.	870,789.	447,151.	58,302.	34,049.	27,596.
1976	258,436.	200,117.	881,261.	488,080.	55,069.	34,535.	31,423.
1977	262,362.	209,256.	892,053.	529,853.	51,635.	34,996.	35,438.
1978	266,395.	218,542.	903,246.	573,121.	48,070.	35,473.	39,643.
1979	269,932.	285,182.	1,022,920.	617,086.	44,307.	35,925.	44,092.
1980	273,502.	356,567.	1,145,416.	662,460.	40,406.	36,388.	48,895.
1981	277,444.	370,814.	1,159,694.	707,657.	36,278.	36,816.	54,074.
1982	281,296.	385,000.	1,173,740.	753,507.	31,995.	37,228.	59,659.
1983	285,109.	399,066.	1,187,374.	800,818.	27,592.	37,668.	65,680.
1984	288,936.	412,992.	1,200,555.	851,011.	23,099.	38,149.	72,172.
1985	292,812.	426,629.	1,213,066.	905,041.	18,497.	38,703.	79,177.

PROJECTED REQUIREMENTS FOR FULL-TIME EQUIVALENT REGISTERED NURSES

Year	Short-term inpatient	Hospital outpatient	Physician office	Nursing homes	Community health	HMO clinic	Other hospitals	Private duty + misc	Educators	Total
1972	385,300	23,800	42,000	50,200	73,900	1,700	56,500	37,700	22,800	694,000
1973	398,800	25,100	42,600	55,100	75,800	2,100	58,600	35,900	22,700	716,500
1974	413,000	26,400	43,200	60,300	77,600	2,400	60,500	34,100	22,400	739,900
1975	427,700	27,700	43,700	65,800	79,500	2,700	62,600	32,400	22,200	764,300
1976	442,700	29,100	44,200	71,200	81,300	3,100	64,600	30,700	22,000	788,900
1977	458,300	30,400	44,700	76,700	83,100	3,500	66,600	29,200	22,000	814,500
1978	474,600	31,700	45,200	82,400	86,000	3,900	68,700	27,700	34,800	854,000
1979	490,700	41,400	60,800	88,200	86,800	4,400	70,700	26,400	37,400	906,700
1980	507,500	51,800	81,000	94,200	88,600	4,900	72,700	25,000	23,200	948,900
1981	525,500	53,800	82,700	100,200	90,400	5,400	74,700	23,800	23,000	979,500
1982	544,100	55,900	84,300	106,200	92,200	5,900	76,800	22,600	23,000	1,011,000
1983	563,300	57,900	85,800	112,400	94,100	6,500	78,800	21,500	23,100	1,043,500
1984	583,300	60,000	87,300	119,000	95,900	7,200	80,800	20,400	23,400	1,077,300
1985	604,200	61,900	88,600	126,200	97,800	7,900	82,900	19,400	23,500	1,112,200

PROJECTED REQUIREMENTS FOR TOTAL EMPLOYED REGISTERED NURSES

Year	Short-term inpatient	Hospital outpatient	Physician office	Nursing homes	Community health	HMO clinic	Other hospitals	Private duty + misc	Educators	Total
1972	450,800	27,800	48,700	63,300	78,800	2,000	59,400	44,100	24,600	799,500
1973	466,600	29,300	49,400	69,500	80,800	2,400	61,500	42,000	24,500	826,700
1974	483,200	30,800	50,100	76,000	82,700	2,800	63,600	39,900	24,200	853,300
1975	500,400	32,300	50,600	83,000	84,700	3,100	65,900	37,900	24,000	881,900
1976	518,000	34,000	51,200	89,800	86,700	3,600	68,000	35,900	23,700	910,900
1977	536,200	35,500	51,800	96,700	88,600	4,100	70,100	34,200	23,700	940,900
1978	555,300	37,000	52,400	103,900	90,600	4,500	72,300	32,400	37,500	985,900
1979	574,100	48,300	70,500	111,200	92,500	5,100	74,400	30,900	40,400	1,047,400
1980	593,800	60,500	93,900	118,800	94,400	5,700	76,500	29,200	25,000	1,097,800
1981	614,800	62,800	95,800	126,400	96,400	6,300	78,600	27,800	24,800	1,133,700
1982	636,600	65,200	97,700	133,900	98,300	6,800	80,800	26,400	24,800	1,170,500
1983	659,100	67,600	99,400	141,700	100,300	7,500	82,900	25,200	24,900	1,208,600
1984	682,500	70,000	101,200	150,100	102,200	8,300	85,000	23,900	25,200	1,248,400
1985	706,900	72,200	102,700	159,100	104,300	9,200	87,200	22,700	25,400	1,289,700

EFFECT OF ROLE REFORMULATION ON FTE NURSE REQUIREMENTS ASSUMING PRODUCTIVITY PROPORTIONAL TO WAGES

Year	RNS	LPNS	CNS	Aides	NPS
1972	1,089.	1,039.	0.	-3,202.	2,456.
1973	2,566.	1,925.	41.	-6,887.	2,837.
1974	4,348.	2,507.	87.	-10,718.	3,207.
1975	6,456.	2,759.	138.	-14,703.	3,560.
1976	8,908.	2,653.	196.	-18,836.	3,896.
1977	11,731.	2,167.	261.	-23,135.	4,226.
1978	14,955.	1,273.	333.	-27,622.	4,555.
1979	18,569.	-55.	414.	-32,238.	8,729.
1980	22,621.	-1,839.	503.	-37,043	15,898.
1981	27,171.	-4,110.	602.	-42,102.	16,926.
1982	32,209.	-6,895.	712.	-47,364.	17,919.
1983	37,766.	-10,221.	833.	-52,848.	18,857.
1984	43,875.	-14,118.	967.	-58,575.	19,729.
1985	50,572.	18,617.	1,115.	-64,565.	20,551.

Table B-20.—Detailed results, high combined scenario

PROJECTED SERVICE DEMANDS (000's)

Year	Patient days	Outpatient visits	Office visits	Type 1 NH days	Type 2 NH days	Home visits	HMO clinic visits
1972	242,319.	164,080.	838,566.	329,848.	66,648.	33,434.	17,565.
1973	246,207.	173,019.	849,343.	367,126.	63,961.	33,941.	20,799.
1974	250,417.	183,058.	860,138.	406,117.	61,174.	33,483.	24,096.
1975	254,460.	191,002.	870,400.	447,151.	58,302.	34,048.	27,933.
1976	258,246.	149,942.	880,080.	488,079.	55,069.	34,536.	32,455.
1977	261,271.	208,879.	884,604.	529,853.	51,838.	34,996.	37,541.
1978	265,749.	217,557.	899,204.	573,121.	48,076.	35,473.	43,113.
1979	279,529.	310,343.	1,276,576.	617,085.	44,307.	35,935.	49,127.
1980	293,458.	435,952.	1,680,418.	662,460.	40,406.	36,388.	55,627.
1981	297,304.	441,581.	1,675,957.	707,657.	36,278.	36,816.	62,643.
1982	300,805.	456,788.	1,690,286.	753,507.	31,996.	37,238.	70,216.
1983	304,317.	471,580.	1,708,520.	800,818.	27,582.	37,665.	78,391.
1984	307,793.	485,984.	1,715,782.	851,011.	23,069.	38,149.	87,213.
1985	311,276.	499,942.	1,726,836.	906,041.	18,497.	38,703.	96,736.

PROJECTED REQUIREMENTS FOR FULL-TIME EQUIVALENT REGISTERED NURSES

Year	Short-term inpatient	Hospital outpatient	Physician office	Nursing home	Community health	HMO clinic	Other hospitals	Private duty + misc	Educators	Total
1972	385,300	23,800	42,000	50,200	73,900	1,700	58,500	37,700	24,500	695,500
1973	400,800	25,100	42,900	55,100	75,500	2,100	58,500	38,900	24,500	720,500
1974	417,500	26,400	43,800	60,300	77,600	2,400	60,500	34,100	24,500	747,100
1975	435,700	27,700	44,800	65,800	79,500	2,800	62,600	32,400	24,700	775,700
1976	455,100	29,000	45,500	71,300	81,500	3,200	64,600	30,700	24,800	805,300
1977	476,200	30,300	45,900	76,700	83,100	3,700	66,600	29,300	25,100	836,800
1978	499,000	31,600	46,400	82,400	85,000	4,300	68,700	27,700	81,000	926,000
1979	541,100	46,200	114,300	88,200	86,800	4,900	70,700	26,400	92,300	1,070,800
1980	586,800	61,800	204,000	94,200	88,600	5,500	72,700	25,000	34,300	1,173,000
1981	617,100	64,100	212,700	100,200	90,400	6,200	74,700	23,800	34,400	1,223,700
1982	649,600	66,300	221,100	106,300	92,300	7,000	76,800	22,600	34,700	1,276,400
1983	684,300	68,500	229,100	112,400	94,100	7,800	78,800	21,500	35,100	1,331,600
1984	721,600	70,600	236,700	119,000	95,900	8,700	80,800	20,400	35,800	1,389,400
1985	761,500	72,600	243,700	126,300	97,800	9,800	82,900	19,400	36,700	1,450,200

PROJECTED REQUIREMENTS FOR TOTAL EMPLOYED REGISTERED NURSES

Year	Short-term inpatient	Hospital outpatient	Physician office	Nursing homes	Community health	HMO clinic	Other hospitals	Private duty + misc	Educators	Total
1972	450,800	27,800	48,700	63,300	78,800	2,000	59,400	44,100	26,200	801,100
1973	468,700	29,300	49,700	69,500	80,800	2,400	61,500	42,000	26,400	830,300
1974	488,500	30,800	50,800	76,000	82,700	2,800	63,600	39,900	26,400	861,500
1975	509,800	32,300	51,700	83,000	84,700	3,200	65,900	37,900	26,700	895,200
1976	532,500	33,800	52,500	89,900	86,700	3,700	68,000	35,900	26,800	929,700
1977	557,200	35,400	53,200	96,700	88,600	4,300	70,100	34,200	27,100	966,800
1978	583,800	36,900	53,800	103,900	90,600	5,000	72,300	32,400	87,400	1,066,100
1979	633,100	53,900	132,500	111,300	92,500	5,700	74,400	30,900	99,600	1,233,800
1980	686,600	72,100	236,400	118,800	94,400	6,400	76,500	29,200	37,000	1,357,400
1981	722,000	74,800	246,500	126,400	96,400	7,200	78,600	27,800	37,100	1,416,800
1982	760,000	77,400	256,300	133,900	98,300	8,100	80,800	26,400	37,400	1,478,600
1983	800,600	79,900	265,500	141,700	100,300	9,000	82,900	25,200	37,900	1,543,000
1984	844,300	82,400	274,300	150,100	102,300	10,100	85,000	23,900	38,600	1,610,900
1985	891,000	84,700	282,400	159,100	104,300	11,100	87,200	22,700	39,600	1,682,100

EFFECT OF ROLE REFORMULATION ON FTE NURSE REQUIREMENTS ASSUMING PRODUCTIVITY PROPORTIONAL TO WAGES

Year	RNS	LPNS	CNS	Aides	NPS
1972	1,089.	1,039.	0.	-3,302.	2,454.
1973	4,316.	2,609.	54.	-10,788.	3,163.
1974	8,739.	3,066.	116.	-19,076.	3,846.
1975	14,455.	2,372.	186.	-28,114.	4,496.
1976	21,550.	366.	262.	-37,924.	5,097.
1977	30,129.	-3,018.	346.	-48,572.	5,662.
1978	40,311.	-7,866.	445.	-60,138.	6,195.
1979	54,136.	-14,874.	562.	-75,374.	36,351.
1980	70,769.	-24,143.	671.	-92,616.	96,284.
1981	87,474.	-34,777.	803.	-108,261.	106,223.
1982	106,296.	-47,413.	946.	-125,076.	113,808.
1983	127,361.	-62,144.	1,111.	-143,131.	121,027.
1984	150,795.	-79,096.	1,290.	-162,516.	127,812.
1985	176,726.	-98,383.	1,486.	-183,318.	134,074.

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Appendix C

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